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PERCEIVED USEFULNESS OF THE TEAM TACTICAL ENGAGEMENT SIMULATOR (TTES): A SECOND LOOK

by

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13. ABSTRACT *(Maximum 200 words)*

The U.S. Marine Corps Team Tactical Engagement Simulator (TTES) will provide a realistic simulated combat environment where military and civilian personnel can receive training in discretionary decision making (learning when to engage or not engage a potential adversary) as well as marksmanship. This study evaluated the training value of TTES, as perceived by 28 subject matter experts from six military and civilian agencies. The experts rated the potential usefulness of incorporating numerous factors into TTES simulations, provided opinions on TTES current capability for meeting training needs, and judged the realism level required for adequate training. Since a similar evaluation had been carried out in 1994, progress during the past year was estimated.

Respondents generally gave very high ratings (an average of over 94%) for the potential usefulness of including a wide variety of factors in TTES, and expect realism to be good to very good. Current capability was judged at about 60% of potential, and has improved about 40% in the past year. The average usefulness rating of over 94% suggests that TTES eventually could result in phenomenal savings in time, ammunition, and other training costs, while providing experiences and challenging trainees in ways not currently possible.

14. SUBJECT TERMS
Computer-controlled hostiles; Computer-controlled neutrals; Discretionary decision making; Human behavior; Human factors; Marksmanship trainers; Modeling and simulation; Simulated humans; Tactical decision making; Team Tactical Engagement Simulator; TTES; Virtual reality

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1.0 EXECUTIVE SUMMARY

A study has been conducted in 1995 to evaluate the training value of the U.S. Marine Corps Team Tactical Engagement Simulator (TTES), as perceived by 28 subject matter experts from six military and civilian agencies. This study was a follow-on to a similar 1994 evaluation. TTES is being developed to provide a deployable, affordable, realistic simulated combat environment where military and civilian personnel can receive training in making discretionary decisions (learning *when* to engage or not engage a potential adversary) as well as marksmanship.

All of the evaluators were experienced small arms trainers; 23 were military officers or enlisted personnel with infantry or security backgrounds and five were civilian law enforcement officers. The study participants used the current TTES system or observed it in use and received a briefing on the capabilities envisioned for the ultimate system. Then each completed a detailed questionnaire, using a 5-point scale to rate the *Potential Usefulness* of incorporating numerous factors into TTES simulations. Respondents also provided their opinions on TTES *Current Capability* for meeting training needs and on required *Realism Levels*.

Respondents generally gave very high calculated ratings (86 to 98%, with an average of 94.6%) for the usefulness of including the listed sets of factors in TTES — substantially higher ratings than were given by participants in the 1994 survey (an average of 83.8%). From among the 17 categories included in the survey, respondents indicated that Sounds, General Objects, and Simulated Humans were the most useful to simulate, though distances between all adjacent ratings were small and even the bottom-rated item, Eye Movements for Adversaries, was rated at 86.7%. Good to very good realism is needed for all objects, situations, and events.

As was the case in 1994, the 1995 ratings emphasized how important it is that TTES not constrain the activities of its users any more than absolutely necessary. The provided equipment should allow users to carry out common battlefield activities and procedures during training in a natural, normal manner so the skills gained will transfer directly to combat situations.

Modeling simulated adversaries in reasonably realistic detail was considered more important by the 1995 respondents than by those in 1994. These results alleviate 1994 concerns that there might be a general attitude that the adversary is inherently less capable and thus requires a less sophisticated representation in TTES. Such a perception would be extremely dangerous in real-world combat, and nothing in training must be allowed to reinforce this misconception in any way. The adversaries engaged during TTES training must appear to be bright, clever, and fully capable of carrying out well-planned and skilled coordinated tactical movements. Neutrals and friendlies must be realistic enough so intelligent judgments are needed when deciding whether to engage.

TTES *Current Capability* was judged to have improved considerably in the past year. 1995's 60.2% average rating was up significantly from 1994's 42.0%. Modeling of the Environments category (urban, jungle, desert, etc.) was considered the best at present, while the Environmental Effects category (weapon impacts, reduced visibility, etc.) was rated among the lowest.

The 1994 survey respondents' ratings indicated that the envisioned TTES system potentially might meet between 80 and 85% of their perceived needs for marksmanship and discretionary decision training. In 1995 the calculated overall average *Potential Usefulness* rating was over 94%. These findings suggest that a simulator system such as TTES eventually could result in phenomenal savings in time, ammunition, and other costs related to training, while providing the capability to train to higher standards and to challenge trainees in ways not currently possible.

2.0 INTRODUCTION

2.1 BACKGROUND

The Team Tactical Engagement Simulator (TTES) project is part of a service-wide effort to utilize advanced modeling and simulation techniques for training individual combatants. These individual combatants include infantry, security forces, special operations forces, and law enforcement personnel. The TTES research and development effort is sponsored by the U.S. Marine Corps and is being carried out under the leadership of the Naval Air Warfare Center Training Systems Division (NAWC-TSD), Orlando, Florida. Primary developer of the simulation software is the Institute for Simulation and Training (IST), University of Central Florida, Orlando, Florida.

The *TTES Advanced Technology Demonstration* effort was begun in fiscal year 1993 to develop core technology for individual combatant and small-unit force-on-force training devices, and will continue through fiscal year 1996. Two Defense Modeling and Simulation Office awards and associated teaming with other Department of Defense agencies have enhanced TTES contributions to joint *Individual Combat Simulation System* efforts.[1]

It is anticipated that the TTES training systems will be used by the U.S. Marine Corps, U.S. Army, U.S. Air Force, Security Police, Special Operations Forces, and various civilian law enforcement agencies such as the Federal Bureau of Investigation and the U.S. Drug Enforcement Agency. Thus it is important to ensure that the planned TTES simulations have the capability to meet the needs of both trainers and trainees in those various agencies.

TTES emphasizes tactical decision-making and close combat marksmanship skills in a *Dynamic Synthetic Environment* (DSE), complementing live-fire and field training. The DSE includes (1) a dynamic representation of the physical environment and (2) behavioral representation of friendlies, hostiles, and neutrals. That is, training can be conducted in a realistic simulated combat environment where trainees will encounter computer-controlled hostile and neutral (CCH/N) entities whose high-fidelity simulated combat behavior will closely emulate that of actual hostile and neutral units and individuals. An initial attempt at defining battlefield behaviors of five kinds of hostile and neutral individuals has been completed for TTES modeling of CCH/Ns as a companion effort to this determination of perceived TTES training value.[2, 3]

TTES is not merely a marksmanship trainer, although it will provide both individuals and teams the opportunity to practice small arms and other weapons skills. More important, TTES will train *when* to shoot as well as *how* to shoot. TTES eventually will be capable of emulating a

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[1] Marine Corps System Command. *Team Tactical Engagement Simulator (TTES) Advanced Technology Demonstration*, by F.J. Wysocki and D.H. Fowlkes. Quantico, Vir., Amphibious Warfare Technology Directorate, February 1994.

[2] Naval Postgraduate School. *Battlefield Behaviors of Neutrals and Hostiles: Models for the Team Tactical Engagement Simulator (TTES)*, by J.H. Lind. Monterey, Calif., NPS, September 1995 (NPSOR-95-006)

[3] Naval Air Warfare Center Weapons Division. *Behavior Representation for the Team Tactical Engagement Simulator (TTES)*, by J.H. Lind. China Lake, Calif., NAWCWPNS, in preparation. (NAWCWPNS TP 8224)

variety of humans, ranging from desperate criminals and mobs, through well-trained or marginally-trained enemy forces, to neutral or unfriendly villagers, friendly allies, hostages, and prisoners. Using TTES, trainees will have the opportunity to hone their skills related to recognizing the intent and level of hostility of individuals and groups, and learn to make intelligent decisions concerning when to engage and when to withhold fire. Indeed, it is anticipated that improved tactical and decision making skills will be the most significant TTES training payoff.

2.1.1 Envisioned TTES System

TTES is a virtual reality training device under development in the Marine Corps technology base. TTES is intended as a supplement and complement to live-fire and field training, not as a substitute. The software developed in the effort can be applied as a modular upgrade to compatible small arms training systems for infantry, security force, and special operations units. The envisioned TTES product is projected for fielding in the 2002 to 2006 timeframe.

The TTES training device will be deployable, affordable, and easy to produce. Oriented to individual combatants and small units, TTES technology will contribute to operational readiness by enabling mission preparation in operationally relevant synthetic environments. Trainees also will be able to utilize a variety of combat weapons in realistic tactical situations while traversing a simulated environment that includes open terrain, villages, and various kinds of buildings. When TTES is provided, an appropriate terrain database of an objective area will be available, along with computer-controlled hostiles characterized to emulate the behaviors of the expected enemy. Such capabilities will enable mission previews and mission rehearsals specific to the anticipated combat situation in a realistic emulation of the objective area.

The envisioned TTES system will fully immerse fire team members in a common virtual reality using wide-angle screens and/or helmet-mounted displays with audio capabilities, for training as a coordinated tactical unit in the same synthetic environment. Multiple trainees will be able to interact with each other while linked via a radio frequency network using Distributed Interactive Simulation (DIS) protocols, so that they are not constrained by signal-carrying wires. Trainees also will be networked with CCH/Ns via DIS protocols, enabling emulation of force-on-force engagements against various adversaries in areas where neutral and friendly forces are present.

The refinement of discretionary and tactical decision skills will be the most significant TTES payoff. Other payoffs include maintenance of perishable skills, realistic training in expeditionary situations such as during prolonged shipboard deployments, and weapon virtual prototyping.

2.1.2 Current TTES Emphasis

The current thrust of TTES is Military Operations in Urban Terrain (MOUT). This emphasis was chosen for mission relevance and for a sufficient challenge during technology evolution. Tactical decision skills and close combat marksmanship skills are the training facets emphasized at this time.

TTES development is focused initially on general purpose infantry. Scenarios for training security forces are next in line. Training for special operations units and rear-area security situations will follow. The basic technology will meet requirements for and be applicable to training programs for all military services. Near-term TTES capabilities also will be useful for various civilian law enforcement agencies.

2.1.3 TTES Equipment

The current TTES evaluation hardware suite is illustrated in Figure 1. Each TTES suite includes an 8- by 10-foot rear-projection display screen, a projector, an M16-A2 demilitarized rifle and weapon monitor, a head-position tracker, microphone and headphones, a foot pedal for movement control, and a computer graphics generator, along with the TTES software that runs the program. Two or more suites can be used concurrently for team training. The trainee aims the weapon as desired, looks through the sight, and pulls the trigger to fire a virtual round that follows a ballistic path through the virtual battle space.

Pressure on the forward end of the foot pedal causes the system to move the trainee forward through the environment at a rate proportional to the amount of pressure. Pressure on the back of the plate results in the appearance of moving backwards. The head-tracking device is attached to a helmet that is worn during the training exercise. Moving the head left or right causes the projected scene to move appropriately to display new areas. The microphone and headphones enable communications among trainees in separate TTES stations who are practicing team exercises.

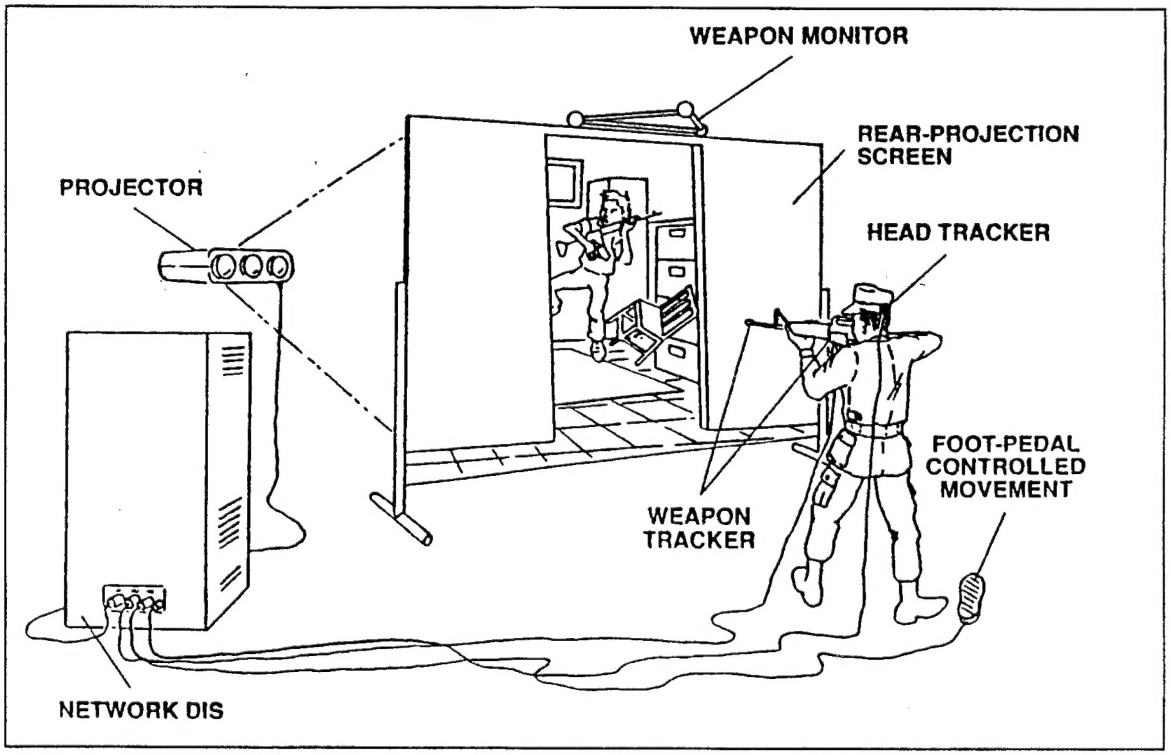

Figure 1. Current TTES Evaluation Hardware Suite.

The envisioned TTES system for 2002, shown in Figure 2, includes weapon and body monitors, non-tethered tracking emitters that transmit signals related to human motion, a foot-controlled movement device, a head-mounted visual and audio display, a trainee computer pack, and a master computer with a radio frequency DIS network. Eventually (in the 2006 timeframe) the use of DIS network technology will allow very localized combined arms training involving combat platforms and aviation assets via their respective virtual reality simulators linked into a common virtual battle space. This ultimate system is illustrated in Figure 3.

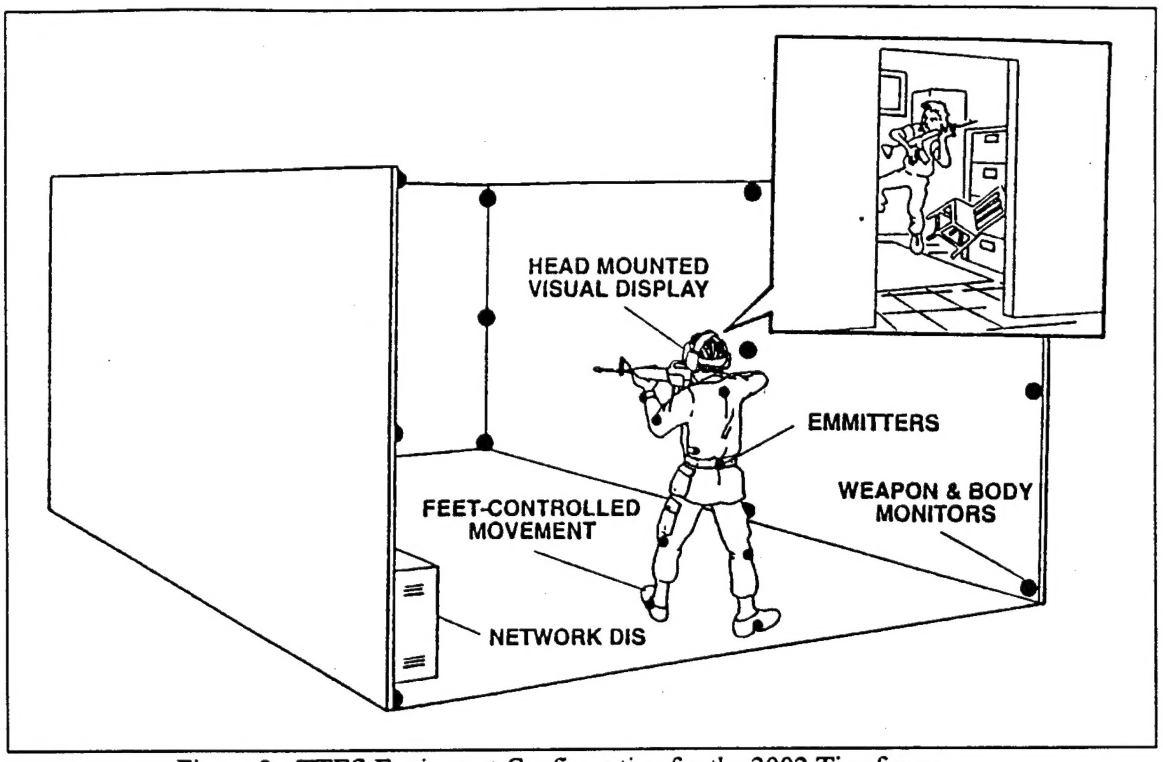

Figure 2. TTES Equipment Configuration for the 2002 Timeframe.

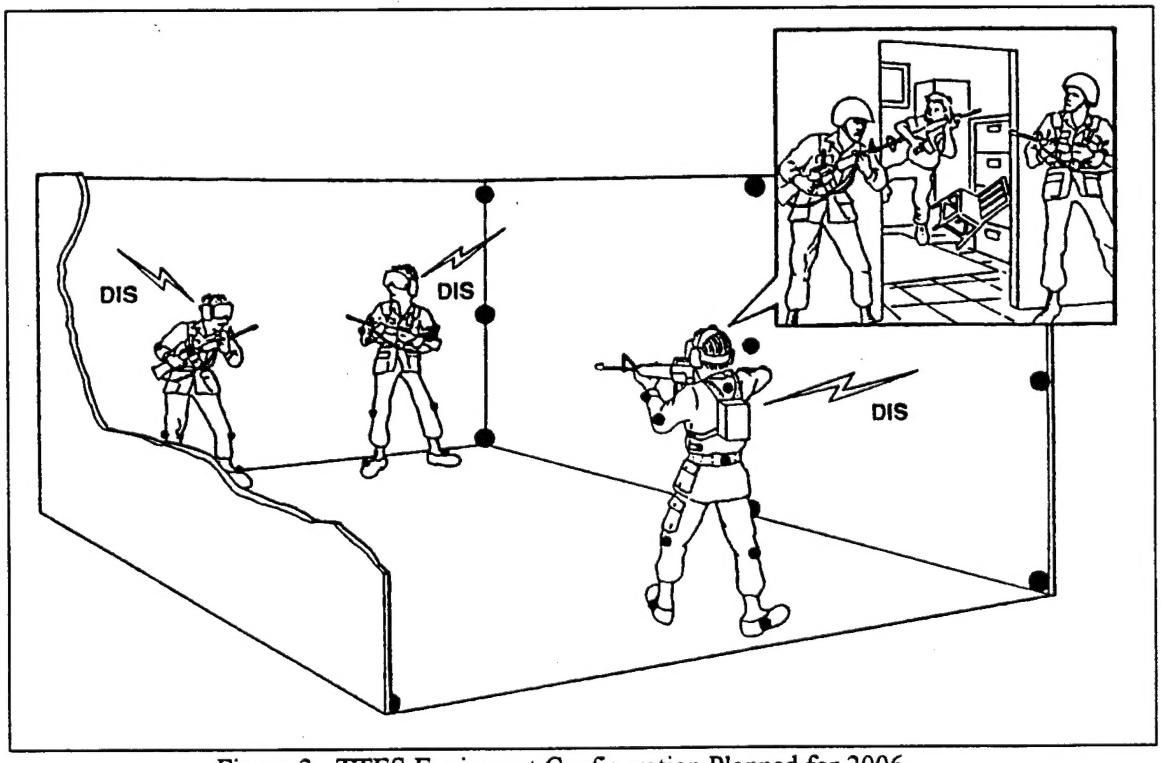

Figure 3. TTES Equipment Configuration Planned for 2006.

2.2 GOAL OF STUDY

The goal of the present study is to determine the degree to which TTES, as currently developed and envisioned, will be of value to those numerous military and civilian agencies that may make use of it for both discretionary decision and marksmanship training. A detailed survey of a limited number of subject matter experts was carried out for this purpose in May 1995, as a follow-on to a similar survey conducted a year earlier in May 1994.[4] A comparison of the results of the two surveys permits a rough determination of the rate at which TTES development is progressing towards a fully-satisfactory system.

2.3 STUDY APPROACH

Several techniques are commonly used to obtain perceptions, opinions, and judgments from subject matter experts. These generally fall into two categories: personal interviews and questionnaires.

Personal interviews are used to present the situation verbally, then to obtain verbal responses to situations and questions. Such interviews can be *undirected* and open-ended, eliciting those comments that happen to come to mind and that the expert wishes to provide. Interviews also can be *directed* and structured, with the interviewer asking a prepared set of questions and noting the responses. Interviews are useful for obtaining opinions when the possible set of responses is unknown or when respondents are unlikely to take the time to complete a questionnaire. They are expensive since they require a great deal of time on the part of the interviewer, and results may be difficult to analyze.

A third interview technique is referred to as the *verbal protocol* method. The expert actually uses the system being evaluated (or a simulation of it), and verbally provides perceptions and opinions while going through a typical scenario. Like other interview techniques, the verbal protocol method is costly to use and results are hard to analyze. Unlike other interview techniques, this methodology requires that the system be available for use in a form that adequately represents what the final system will be like. The TTES prototype system is still in its development stage; thus the use of this technique was deemed inappropriate for now.

Questionnaires, unlike interviews, require that the surveyor know in advance what information generally is sought. Questionnaires can be *open-ended*; these are used to obtain opinions when the surveyor does not wish to prejudice the expert by providing a prescribed set of possible responses. Open-ended questionnaires are time-consuming to analyze, but sometimes are the only way to obtain needed opinions.

Structured questionnaires are used for the opposite situation: when the surveyor has prepared a limited set of responses that are to be judged in some manner. The expert then may be asked to select one or more responses, to rank the responses, or to rate them on a scale of 1 to 5 or 1 to 7. Such questionnaires must be thoughtfully prepared to avoid biasing the results.[5] Once the

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[4] Naval Air Warfare Center Weapons Division. *Team Tactical Engagement Simulator (TTES): Perceived Training Value*, by J.H. Lind and S.R. Adams. China Lake, Calif., NAWCWPNS, December 1994. (NAWCWPNS TM 7724)

[5] D. Meister. *Behavioral Analysis and Measurement Techniques*. New York, John Wiley and Sons, 1985.

questionnaire is prepared, questionnaire administration is cost effective and analysis is straightforward.

One technique that uses both open-ended and structured questionnaires is referred to as the *Delphi* method.[6] Experts first respond to general open-ended questions, within provided guidelines. Summary statistics are generated from the results. These are used to prepare a second questionnaire for submission to the experts, for further refining of responses. The conventional *Delphi* method continues iteration of questions and responses until the response distribution converges. However, Sackman has suggested that feeding back "correct" responses to participants biases the results.[7] Thus two iterations usually are considered adequate for most studies.

Cost and time considerations have led to selection of the modified *Delphi* method described above to obtain the judgments needed for this study. An initial open-ended survey in 1994 provided lists of potential TTES capabilities that might be considered by developers. These lists were used to prepare a detailed structured questionnaire. As noted above, two separate surveys were conducted approximately one year apart, using essentially the same questionnaire and participants from similar backgrounds. Details of the application of the method are provided in Section 3.0. The questionnaire used for data collection is reproduced in Appendix A.

2.4 SCOPE AND VALIDITY OF STUDY

2.4.1 Participant Representativeness

The survey discussed in this report makes use of subject matter experts to obtain judgments of the value of TTES as a training system. Attempts were made to utilize as diverse a sample of potential TTES users as possible. However, time and funding constraints have bounded the project, and the use of a limited number of experts from several activities is a weakness of this study (a wider phase of evaluations will be conducted between July 1996 and July 1997). Twenty-eight military and civilian marksmanship trainers were used as the experts in 1995; 21 others had been used in 1994 (see Sections 3.2 and 3.3). These individuals primarily were drawn each year from six agencies and commands. With only a limited number of experts and only a few potential user agencies involved in the survey, the sample may not be representative of the total potential TTES user population and may be biased by the missions of those surveyed.

2.4.2 Combining Military and Civilian Responses

1995 survey respondents have been divided into two groups: military personnel and civilian law enforcement agents. Questionnaire responses were recorded and analyzed separately for each group, to determine whether it was appropriate to combine them. As reported in Section 5.1.2, the general *order* of option selections remained relatively constant across groups, while numerical *rating values* varied somewhat. Overall average ratings from the civilian and the military respondents did not differ in any significant way. Grouping of the responses is not expected to bias survey results substantially.

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[6] N. Dalkey and O. Helmer. "An Experimental Application of the Delphi Method to the Use of Experts." *Management Science*, Vol. 9 (1963).

[7] Rand Corporation. *Delphi-Assessment: Expert Opinion, Forecasting, and Group Processes*, by H. Sackman. Santa Monica, Calif., Rand, 1974. (Report No. R-1283-PR)

2.4.3 Validity of Civilian Responses

With only five participants in the civilian group, little validity can be implied for this group's responses, when considered separately. Potential TTES usefulness and current capability rating values are provided in this report for the five civilians, but it must be recognized that they do not represent an adequate sample. Civilian results are reported separately in Section 5 for completeness and so differences and similarities can be observed, for those interested. Although the resulting trends may be useful, great caution should be taken in making any hard inferences from this individual group's results.

2.4.4 Participant Responsiveness

Questionnaires used for data collection were carefully designed to be as comprehensive as possible. As a result, they were quite long and required approximately 30 minutes to complete. Most of the respondents were observed while completing the forms, both in 1994 and 1995, and appeared to take the process seriously and to approach the task thoughtfully. Based on these observations, we feel that the responses are valid for the sample that was surveyed.

2.4.5 Comparisons Between 1994 and 1995 Results

Surveying the same individuals both in 1994 and 1995 was not possible. Only those invited to attend the TTES demonstrations were available to participate in the surveys, and different military personnel and civilians were selected for attendance each year. Nonetheless, survey results obtained in 1995 have been compared with those from the 1994 survey to obtain a rough indication of the level of improvement in TTES over the past year.

The comparisons have some credibility since, although different participants were used, the 28 1995 respondents generally came from the same kinds of military and civilian communities as the 21 1994 respondents. In 1994, 62% were experienced small arms trainers; in 1995, all respondents were involved in training to some extent. Civilians made up 14% of the sample in 1994 and 18% 1995, with the rest drawn from various military facilities. Military ranks (which generally equate to experience levels) were similarly distributed for the two years.

Substantially higher TTES usefulness and capability values generally were assigned by the 1995 participants. Although this may indicate that major improvements have been made in TTES in the past year, differences may be the result (at least in part) of using different samples from the target populations, and relatively small samples at that. Comparisons of the results from the two surveys must be considered approximate and very general in nature.

2.4.6 Capability Ratings for Unimplemented Factors

The questionnaire asked for both *Potential Usefulness* and *Current Capability* ratings for the same list of simulation factors. Some of the listed situations, events, and objects are not yet implemented in TTES, even in rudimentary form (Trench warfare, Fighting hole tactics, Arctic environment, Bridges, etc.). Thus actual observation of these items could not always be used for judgments of *Current Capability*.

Participating experts were instructed to rate the things they had observed in TTES, but also were invited to provide judgments on things they had not actually seen but could imagine, based on the quality of what presently is available in TTES and on descriptions of the envisioned system. Resulting ratings thus represent *hypothesized* capability levels, indicating how good the respondents feel these unimplemented TTES capabilities *would* be, if they were present.

3.0 METHODOLOGY

3.1 PRELIMINARY 1994 SURVEY

As prescribed by the *Delphi* method, a preliminary open-ended survey was conducted in early 1994 to elicit general information on the kinds of capabilities that should be included in the TTES system. A questionnaire was completed by a group of 31 subject matter experts who provided unconstrained inputs on the firing positions, individual movements, and coordinated tactical movements they would like to see as part of TTES. Information on head, eye, arm, and hand movements also was elicited, along with the objects that should be present in the simulations. Training situations, shooting events, etc., also were included by this initial group of respondents.

3.2 COMPREHENSIVE 1994 SURVEY

Continuing with the *Delphi* method, results of the preliminary survey, along with verbal inputs from experts, were used to develop a comprehensive 12-page structured questionnaire. The questionnaire was prepared according to the guidelines of the U.S. Army *Questionnaire Construction Manual*[8] and administered to 21 individuals participating in a demonstration of the TTES system in May 1994. Of those subject matter experts surveyed in 1994, 13 were experienced weapons-use trainers (including three civilian law enforcement officers), while eight were U.S. Marine Corps Military Police who had received extensive small arms training. The study participants used the then-current version of TTES and received a briefing on the capabilities the ultimate system will have, prior to completing the detailed survey form.

The 1994 questionnaire asked respondents to rate the *Importance* of various factors making up 15 categories of simulation capabilities that might be included in TTES simulations. Categories included situations, events, environments, objects, humans, weapons, sounds, and tactical and body positions and movements. The importance of including each category, *per se*, was not rated, because inclusion of all categories will be critical for a complete, comprehensive system. However, information on the relative value of each *factor* within a category was needed to set TTES development priorities. Respondents also gave ratings for perceived TTES capability to emulate these factors and categories, both in the system's 1994 form (*Current Capability*) and as TTES is planned when the project is completed (*Potential Capability*). A 5-point rating scale was used to indicate levels of importance and capability.

The 1994 respondents generally gave very high ratings for the importance of including a wide variety of factors in TTES for system realism. Based on ratings assigned by the total group of participants, factors were classified as *critical* to include in TTES, *extremely important* to include, *important* to include, and *consider including* as funds permit. From among the 15 categories included on the survey, respondents indicated that Simulated Adversaries (92.7%) and Sounds (86.7%) were the most important categories of factors needed in TTES. Distances between adjacent ratings were small; even the bottom-rated item, Eye Movements, received a calculated rating of 74.6% in importance for TTES.

The ratings indicated that the experts considered it extremely important that the final TTES system not constrain the activities of its users any more than absolutely necessary. Equipment used by trainees should allow them to carry out, in a normal manner, those procedures and

[8] U.S. Army Research Institute for the Behavioral and Social Sciences. *Questionnaire Construction Manual*, by B.A. Babbitt and C.O. Nystrom. Ft. Hood, Tex., ARI Field Unit, June 1989. (Research Product 89-20)

activities that are common during combat. On the other hand, although the Simulated Adversaries category was the highest rated in importance, *high-fidelity* simulation of the humans who serve as adversaries is considered less important. Various factors in the Arm & Hand, Head, and Eye Movements categories were rated lower than factors in many other categories.

Current Capability was rated relatively low for TTES in 1994 — not surprising since development had not progressed far. The overall calculated total group rating was 42%, while the subgroup of 13 trainers gave a calculated rating of only 39%.

The most significant 1994 finding concerned TTES's *Potential Capability*: ratings indicated that the experts felt TTES will provide very high quality training that can meet between 80 and 85% of their perceived needs for discretionary decision and small arms training. This finding suggests that a simulator system such as TTES eventually could result in phenomenal savings in time, ammunition, and other costs related to training, while providing the capability to train to higher standards and to challenge trainees in ways not currently possible.

3.3 1995 SURVEY

The survey conducted in May 1995 included all 15 categories of simulation capabilities from the 1994 questionnaire, along with the same lists of simulation factors. Two additional survey categories were added to query respondents on how useful and capable TTES is (or will be) for Mission Preview and Mission Rehearsal operations (a separate survey also was used to gather data for these categories; see Appendix B). Again, *Current Capability* judgments were solicited. However, instead of obtaining separate judgments on *Potential Capability* and *Importance*, the term *Potential Usefulness* was used to combine the two concepts. This was done to shorten the survey form slightly while obtaining essentially the same data.

Each of the 17 questionnaire categories was made up of 6 to 27 separate factors that might be modeled. For example, the TTES Training Situations category included *Anti-armor missions, Immediate action drills, MOUT patrolling operations*, etc. An *Other* option was included for additional factors that might occur to respondents (but very few suggestions were made). For each individual factor, respondents were asked to indicate a *Potential Usefulness* rating and a *Current Capability* rating. In addition, respondents were asked to provide their perceptions of TTES *Current Capability* and *Potential Usefulness* for each category as a whole.

Responses were provided on a linear 5-point scale. *Potential Usefulness* was rated from 1 (*very useful*) to 5 (*very useless*). These judgments can assist in prioritizing the order in which simulation categories and factors are addressed during TTES development. *Current Capability* was rated on a scale from 1 (*very good*) to 5 (*very poor*). Results can be used to evaluate how far along trainers perceive TTES to be, as development of system usefulness and realism continues. Factors perceived as close to adequate can receive less attention during continued development than those judged to be lacking in realism and requiring substantial further work.

Also added to the 1995 survey form were questions on the *Realism Level* needed for satisfactory training (while keeping costs down). How good is "good enough"? Required realism ratings were asked only for the section of the survey that concerned TTES objects, situations, and events (Section B). Again, respondents used a 5-point linear scale. The categories were as follows (general terms are used here; see Appendix A for the exact wording used for each question).

1. Exact replication of real-world objects, situations, and events.

2. Good replication, hard to tell it is not real.

3. Reasonable replication, appearance about as expected for this kind of object, situation, or event.

4. So-so replication, appearance somewhat realistic.

5. Crude approximation, just enough to recognize the object, situation, or event.

3.4 STUDY PARTICIPANTS

Twenty-eight male military and civilian personnel participated in the 1995 survey. The following agencies were represented (see Figure 4):

- U.S. Marine Corps Quantico Weapon Training Battalion (WT Bn), Quantico, Virginia: 10
- Marine Corps Security Forces (MCSF) School, Chesapeake, Virginia: 8
- MCSF Battalion Fleet Anti-Terrorist Security Team (FAST), Norfolk, Virginia: 5
- Federal Bureau of Investigation (FBI) Academy, Quantico, Virginia: 2
- San Antonio (Texas) Police Department: 2
- Los Angeles (California) Sheriff's Department: 1

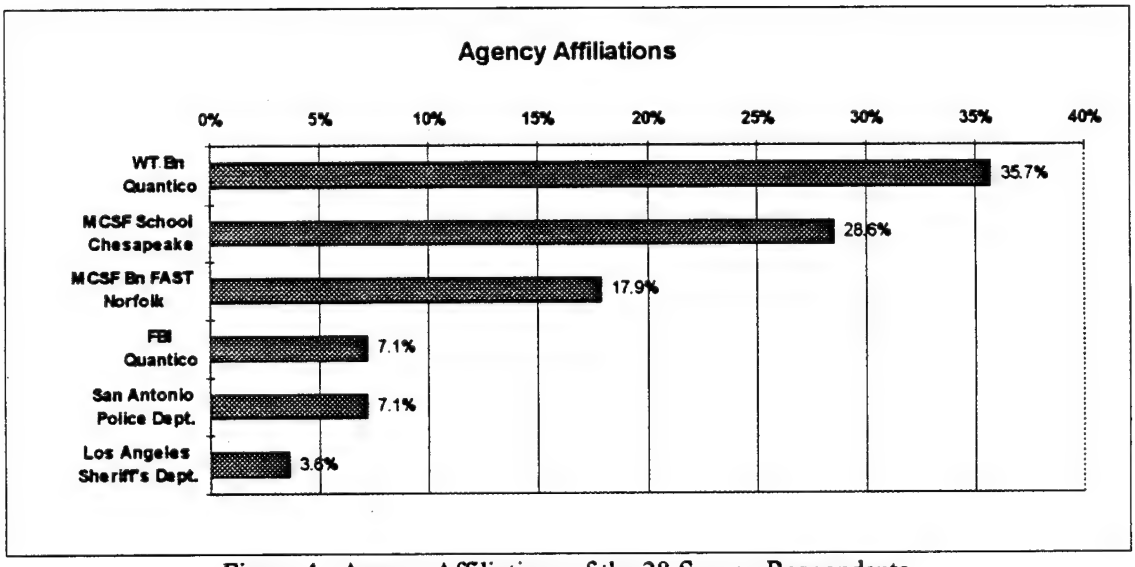

Figure 4. Agency Affiliations of the 28 Survey Respondents.

Of the participants, 23 (82%) were military and five (18%) were civilians. Figure 5 shows the years of training experience reported by the experts. All military participants have infantry or security backgrounds and are responsible for weapons or tactics training. The Weapons Training Battalion teaches marksmanship. MCSF personnel train Marines who guard state embassies, etc. FAST personnel train those responsible for security and anti-terrorist missions at various vital installations.

As discussed in Section 2.4.5, the participants in the 1995 survey were not the same individuals as in 1994, but the 28 1995 respondents generally came from the same military and civilian communities as the 21 1994 respondents. In 1994, 62% were experienced small arms trainers; in 1995, all respondents were involved in training to some extent. In 1994, 14% of the

participants were civilian law enforcement officers while in 1995 civilians made up 18% of the sample; the rest were drawn from various Marine Corps, Army, and Air Force communities. Military ranks (which generally equate to experience levels) were similarly distributed for the two years.

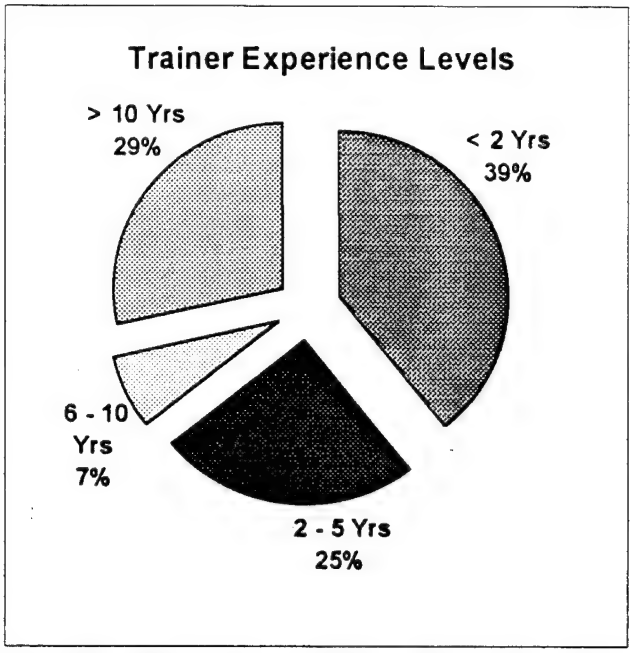

Figure 5. Levels of Experience as Trainers Reported by Respondents.

3.5 SURVEY ADMINISTRATION

The 1994 and 1995 TTES evaluations were both carried out at the Marine Corps MOUT II Quantico Combat Training Village, near Quantico, Virginia, in conjunction with a demonstration of the TTES system. TTES engineers had generated a virtual representation of the MOUT II facility on the training devices. Thus individuals participating in the assessment were able to make tactical observations concerning the TTES MOUT representation and the actual site, along with comparisons between the virtual and the real areas.

In 1994, only one TTES system was available for evaluation, limiting scenarios significantly. In 1995, two one-man TTES systems were set up in a warehouse on the site. Survey participants gathered there for a briefing on the current TTES system and on system capabilities that are anticipated when the simulator project is completed. The weapon used for the TTES demonstrations and evaluations was a demilitarized but fully functional M16-A2 rifle. Participants controlled the area that was viewed on the display screen via a foot pedal that, when depressed, resulted in apparent movement through the simulated scene. The side-to-side view was controlled by direction of gaze, monitored via a head-position tracker contained in a helmet.

Simulated two-man patrol team scenarios were used in 1995, taking advantage of the two TTES systems. The systems were situated so that the two participants could not see each other in the room. Instead, each observed a simulated on-screen trooper representing the other team member as he would appear when located in a position that would be visible in the actual MOUT training village. Communications were via microphones and headphones in the head-position tracker helmets. Thus coordinated actions could be carried out as in the real world.

Exercises lasted about 20 minutes and consisted of moving through the terrain and buildings as desired. TTES users were given the opportunity to traverse the virtual village's open areas and roads and to explore the buildings, including a representation of the actual MOUT II hotel building. This three-story building was simulated in detail, including rooms, corridors, stairs, doorways, and windows. Participants were encouraged to move freely throughout the building and to become familiar with its layout.

During the exercises participants encountered computer-controlled hostiles: semi-realistic emulations of uniformed rifle-bearing enemy soldiers who recognized trainee presence and fired weapons as appropriate. Hostiles were engaged as encountered and the participants had the opportunity to try their decision-making and marksmanship skills. Simplistic representations of neutrals also were included in 1995 (but not in 1994): smaller men wearing red shirts and blue trousers, who appeared in the distance, hurried across the scene, and presented no obvious threat.

Not all survey respondents actually used the TTES system, but all observed other participants going through the scenarios. After the exercises, each respondent was given a copy of the survey form, was verbally instructed about what was requested, and was told that his inputs would be used to guide the continued development of TTES. Respondents were allowed as much time as desired to complete the form, but most completed it in about 30 minutes.

3.6 DATA ANALYSIS AND INTERPRETATION

The 1995 survey results (which are the focus of this report) consisted of *Potential Usefulness*, *Current Capability*, and required *Realism Level* ratings that ranged from 1 to 5, assigned to the individual simulation factors by survey participants. Data were compiled from the 28 survey forms and entered into the Microsoft *Excel* spreadsheet program.[9] Results were calculated for the group of experts as a whole and also separately for the subgroups of military and civilian participants.

The 5-point numerical ratings assigned by the subject matter experts were considered to be interval-level data due to the manner of questionnaire construction. As a result, the individual respondents' values could be combined and normalized onto a 100-point scale. The combined group ratings were calculated for *Potential Usefulness*, for *Current Capability*, and for *Realism Level*. This was done for the total group, the group of military respondents, and the group of civilian respondents.

Calculated ratings were determined for each of the individual factors that made up each of the 17 questionnaire categories. For each factor, the ratings were converted to a 100-point scale (higher is better) by (1) multiplying each individual's rating of 1 by 5, each 2 by 4, etc., (2) summing the resulting values for all responses to that factor question, (3) dividing the sum by the number of listed responses to that question multiplied by 5 (the maximum value possible for that factor), and (4) multiplying the result by 100. Thus the ratings represent a *percent*, based on the ratio of the *value assigned* to the *maximum possible value* that *could* have been assigned by the group for an individual factor. These results are included in Section 5.0.

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[9] Sincere appreciation is expressed to Therese Bilodeau, NPS Operations Research Department Editorial Assistant, who compiled the survey results and entered them into the *Excel* spreadsheets.

Trends in the data (that is, rank orderings) were determined instead of making direct comparisons of adjacent ratings, due to the small sample available for the survey: there is no statistically-significant difference between a calculated *Potential Usefulness* rating of 88.1% for Anti-armor/artillery missions and one of 85.7% for Immediate action drills. However, the observed *trends* are important. When Care for wounded receives a calculated overall *Potential Usefulness* rating of 66.4%, it clearly is considered less important than Building clearing with a rating of 96.4%.

How should the various *Potential Usefulness* responses be interpreted? The subject matter experts who participated in this study were highly experienced, and their opinions should be given considerable weight. Thus we recommend the following *Potential Usefulness* rating classifications.

Potential Usefulness for TTES Training	Calculated Group Ratings
Critical to include in TTES	> 89.9%
Extremely important to include	80.0 - 89.9%
Important to include	70.0 - 79.9%
Consider including, as funds permit	60.0 - 69.9%
Probably *not important* to include	< 60.0%

Current Capability ratings also require some interpretation. For purposes of this study, items rated at less than 50% were considered generally poorly modeled (and sometimes have not been modeled at all). Higher ratings obviously indicated greater satisfaction with the present TTES modeling of a simulation factor — but the calculated numerical capability ratings are of less usefulness than the ranking of items, due to the small sample size.

1995 Total Group *Current Capability* ratings were directly compared with 1994 ratings for the same items (recognizing the validity problems noted in Section 2.4.5) to obtain point and percentage differences between the two years. The results are used here as an indication of modeling progress over the past year, as perceived by the groups of survey experts.

Required *Realism Level* ratings were interpreted much like the *Potential Usefulness* and *Current Capability* ratings. Items with calculated percentages of 80% or better are considered to require Exact replication; between 60 and 80%, Good replication; between 40 and 60% Reasonable replication, etc. (see Section 3.3).

4.0 RESPONSES TO SURVEY QUESTIONS

Results are reported here in the same order and with the same section headings as on the survey form (Appendix A). Factors that are or possibly could be simulated in TTES have been grouped into 17 general categories. These categories then are arranged under three major headings: (1) overall TTES usefulness; (2) TTES objects, situations, and events; and (3) trainee and adversary movements and positions.

Respondents rated the *Potential Usefulness* of each factor and also provided an overall judgment on the usefulness of the entire category of simulation factors. They also rated the *Current Capability* of TTES to emulate each event, situation, or object and provided judgments on overall TTES *Current Capability* to emulate each category of factors as a whole (see Section 2.4.6). In addition, for Section B only, ratings for the required *Realism Level* for each category also were requested.

The following sections provide tables that list group ratings for the *Potential Usefulness* of each factor within each of the survey categories, for TTES *Current Capability* to emulate that factor, and for the required *Realism Level* (when applicable). Each of the questions is stated exactly as posed to the survey participants (shown in boxes). Ratings are provided for the Total Group (the 28 participants as a whole), and also individually for the group of 23 Military participants and the five Civilian law enforcement officers.

Separate tables are provided for *Potential Usefulness* and *Current Capability* for each category of simulation factors. Within each table, the factors have been sorted according to the Total Group's ratings, with the factor considered most useful or most capably modeled at the top. Total Group *Current Capability* responses from the 1994 survey also are included in the tables for comparison with the 1995 results. A rough determination is made of the level of improvement over the past year, based on respondents' judgments.

Some discussion of the results is included in the following sections (primarily for Total Group responses); most results are unsurprising and easy to interpret. Overall judgments of TTES *Current Capability*, *Potential Usefulness*, and *Realism Level* are provided at the bottom of the tables but generally are discussed only minimally in this section; these are covered in more detail in Section 5. However, it should be noted that these Overall ratings are *not* simply averages of the above-listed individual factor ratings. Instead, these are separate ratings provided by the respondents as judgments of the usefulness and capability of the category itself.

4.1 OVERALL TTES USEFULNESS

Section A of the 1995 survey concerned the overall structure and usefulness of the system. Questions were asked concerning (1) the training situations that presently are included and those that eventually will be, (2) training events related to marksmanship, (3) TTES events related to making decisions about how to respond to possible adversaries, (4) capabilities TTES should provide for previewing missions, and (5) capabilities needed to use TTES for mission rehearsals.[10]

[10] Results of a separate survey related to using TTES for mission preview and rehearsal, also conducted this year, are included in Appendix B.

4.1.1 Training Events

1. **TTES training situations**. What training situations should be included in the TTES scenarios and synthetic environment, for maximum TTES usefulness as a training technology?

Potential Usefulness of Listed Factors for TTES Training

- Nine of the listed Training situations are considered *critical* to include in TTES, based on calculated *Potential Usefulness* ratings of 90% or better for the Total Group. Top-rated were Building and Room clearing, along with Close-quarter battle, though differences among the top factors should not be considered statistically significant.

	Potential Usefulness Rating		
TTES Training Situation	**Total Group**	**Military**	**Civilians**
Building clearing	**96.4**	95.7	100.0
Room clearing	**95.7**	94.8	100.0
Close-quarter battle	**94.8**	94.5	96.0
Advance through urban areas	**92.0**	92.0	92.0
Combat rehearsals	**91.5**	89.5	100.0
MOUT patrolling operations	**91.2**	90.5	95.0
Squad & fire team tactics	**91.1**	89.6	100.0
Sniping activities	**90.7**	89.6	96.0
Small unit leadership practice	**90.4**	89.1	96.0
Hostage rescue team activities	**88.6**	87.0	96.0
Anti-armor artillery missions	**88.1**	86.7	100.0
Raid operations	**87.1**	86.1	92.0
Advance-thru-terrain activities	**86.9**	86.7	88.0
Perimeter defense	**86.4**	83.8	100.0
Combined arms operations	**85.9**	83.6	96.0
Immediate action drills	**85.7**	84.3	92.0
Recon operations	**85.0**	81.7	100.0
Ambush operations	**84.3**	81.7	96.0
Unit-to-unit coordination	**82.4**	80.0	100.0
Obstacle breaching tactics	**81.5**	79.1	95.0
Trench warfare	**80.8**	80.0	86.7
Demolition/EOD operations	**80.0**	78.2	93.3
Fighting hole tactics	**79.2**	80.0	73.3
Land navigation practice	**79.2**	77.0	90.0
Guard duty	**74.4**	73.3	80.0
Neutral evacuation operations	**72.8**	70.9	86.7
Care for wounded	**66.4**	61.8	100.0
***Potential* Overall TTES usefulness: Training Situations**	**96.4**	**95.6**	**100.0**

- Thirteen factors were rated between 80 and 90%, classified by the total group as *extremely important* factors to include.

- Four of the listed factors were in the 70 to 80% range, and fell in the *important* to include classification.

- Only Care for wounded rated below 70%; this factor fell in the *consider including* category.

- The five Civilians gave ratings to the individual factors that were equal to or higher than those of the 23 military personnel — with the exception of Fighting hole tactics.

- The total group's 1995 rating for *Potential Usefulness* of these factors is 96.4%; in 1994, the same factors received an average *Importance* rating of only 76.4% (see section 5.1). This represents significant increase during the past year in the perceived usefulness or importance of representing a variety of Training Situations in TTES.

Current Capability of TTES to Emulate Listed Factors

- All but one of the listed Training Situations (Demolition/EOD operations) received higher Total Group *Current Capability* ratings in 1995 than in 1994.

	Current Capability Rating			
TTES Training Situation	**Total Group**	**Military**	**Civilians**	**1994 Total Group**
Building clearing	**75.7**	73.7	85.0	**52.0**
Advance through urban areas	**75.0**	76.3	70.0	**54.4**
Room clearing	**75.0**	74.0	80.0	**54.0**
MOUT patrolling operations	**74.8**	76.0	66.7	**60.0**
Combat rehearsals	**70.0**	68.3	75.0	**48.4**
Squad & fire team tactics	**69.4**	70.0	66.7	**40.0**
Close-quarter battle	**69.1**	68.9	70.0	**51.0**
Small unit leadership practice	**68.0**	67.3	70.0	**41.1**
Recon operations	**64.6**	60.0	75.0	**42.2**
Guard duty	**61.8**	65.0	53.3	**43.3**
Advance-thru-terrain activities	**61.5**	57.8	70.0	**50.0**
Sniping activities	**61.3**	60.0	65.0	**43.3**
Raid operations	**58.7**	60.0	55.0	**48.0**
Perimeter defense	**58.2**	52.5	73.3	**43.3**
Ambush operations	**55.7**	50.0	70.0	**49.5**
Unit-to-unit coordination	**55.0**	53.3	60.0	**37.8**
Combined arms operations	**54.7**	49.1	70.0	**46.7**
Hostage rescue team activities	**54.3**	54.0	55.0	**51.0**
Immediate action drills	**53.7**	49.3	70.0	**35.6**
Land navigation practice	**53.3**	53.3	53.3	**38.9**
Neutral evacuation operations	**49.1**	46.7	60.0	**42.2**
Trench warfare	**46.7**	42.9	60.0	**36.7**
Fighting hole tactics	**42.2**	42.9	40.0	**36.5**
Care for wounded	**42.0**	40.0	46.7	**34.4**
Obstacle breaching tactics	**41.8**	40.0	46.7	**35.6**
Anti-armor artillery missions	**38.0**	35.0	50.0	**35.6**
Demolition/EOD operations	**35.6**	34.3	40.0	**36.5**
***Current* Overall TTES capability: Training Situations**	**69.5**	**71.8**	**60.0**	**45.0**

- The Total Group's Overall Training Situations category rating in 1995 was almost 25 points higher than in 1994, indicating general improvements of more than 50%.

- Greatest improvement appears to be in Squad and fire team tactics (29%) and in Small unit leadership practice (27%). The ability to train using a two-man scenario is seen as a major enhancement to TTES.

- In spite of improvements, seven factors still received *Current Capability* ratings of less than 50%: Neutral evacuation operations, Trench warfare, Fighting hole tactics, Care for wounded, Obstacle breaching tactics, Anti-armor artillery missions, and Demolition/EOD operations. Of these, all but Anti-armor artillery missions also were ranked among the lowest in *Potential Usefulness*. Modeling of these factors for TTES has received little or no attention so far, since other situations are more important for general training.

4.1.2 Marksmanship

2. **TTES events: marksmanship**. What events should be included in the TTES scenarios and synthetic environment to aid in marksmanship training?

Potential Usefulness of Listed Factors for TTES Training

- All but two of the 17 Marksmanship Events were rated at 90% or above in *Potential Usefulness* by the Total Group, placing them in the *critical* to include category.

	Potential Usefulness Rating		
Marksmanship Events	**Total Group**	**Military**	**Civilians**
Quick aim/fire	**97.1**	96.5	100.0
Indoor shots	**96.4**	95.7	100.0
Fire at moving targets	**95.0**	93.9	100.0
Close-range shots	**94.8**	94.8	95.0
Track moving targets	**94.3**	93.0	100.0
Reload weapon	**93.6**	93.0	96.0
Shoot while moving	**93.6**	92.2	100.0
Change weapons (rifle/pistol)	**92.8**	91.8	100.0
Targets at unknown ranges	**92.6**	92.2	95.0
Multiple targets, multiple shots	**92.3**	91.8	95.0
Awkward shooting positions	**92.1**	91.3	96.0
Precision shots at small targets	**91.9**	91.8	92.0
Clear weapon malfunctions	**91.1**	90.0	96.0
Sustained rate of fire	**91.1**	89.6	100.0
Long-range shots	**90.4**	89.6	95.0
Sniping	**87.7**	84.8	100.0
Throw grenades	**87.2**	85.7	95.0
***Potential* Overall TTES usefulness: Marksmanship Events**	**95.0**	**95.0**	**95.0**

- The remaining two simulation factors, Sniping and Throw grenades, each rated at more than 87% by the total group, should be considered *extremely important* to include in TTES.

- The five Civilians rated the *Potential Usefulness* of all of the individual Marksmanship Events higher than the Military respondents, but their Overall rating for the category as a whole was the same.

- *Potential Usefulness* of the Marksmanship Events category was rated 10 points higher in 1995 (95.0%) than was their *Importance* in 1994 (85.0%) by the Total Group of respondents.

Current Capability of TTES to Emulate Listed Factors

- All of the individual listed Marksmanship Events received higher Total Group *Current Capability* ratings in 1995 than in 1994.

	Current Capability Rating			
Marksmanship Events	**Total Group**	**Military**	**Civilians**	**1994 Total Group**
Reload weapon	**77.7**	75.2	88.0	**36.8**
Indoor shots	**76.7**	73.7	88.0	**56.8**
Close-range shots	**69.6**	70.4	65.0	**56.0**
Quick aim/fire	**68.6**	69.6	64.0	**55.0**
Sustained rate of fire	**67.3**	66.7	70.0	**45.3**
Fire at moving targets	**65.6**	68.0	56.0	**43.0**
Shoot while moving	**65.2**	68.9	52.0	**42.1**
Track moving targets	**63.3**	63.2	64.0	**40.0**
Multiple targets, multiple shots	**63.2**	66.7	50.0	**45.3**
Targets at unknown ranges	**63.1**	65.5	50.0	**50.0**
Awkward shooting positions	**61.9**	61.3	64.0	**40.0**
Sniping	**60.0**	62.7	52.0	**39.0**
Long-range shots	**60.0**	62.6	45.0	**49.0**
Clear weapon malfunctions	**57.6**	55.0	64.0	**34.7**
Precision shots at small targets	**56.8**	59.0	48.0	**51.0**
Change weapons (rifle/pistol)	**44.6**	48.0	33.3	**31.6**
Throw grenades	**34.5**	37.5	26.7	**33.3**
***Current* Overall TTES capability: Marksmanship Events**	**71.1**	**71.4**	**70.0**	**46.3**

- The Overall Marksmanship Events category was rated almost 25 points higher in *Current Capability* in 1995, indicating a perceived improvement of more than 50%.

- Reload weapon received the greatest jump in rating, over 40 points, representing an improvement of over 100%.

- Ratings for seven other Marksmanship Events were up 20 points or more: Sustained rate of fire, Fire at moving targets, Shoot while moving, Track moving targets, Awkward shooting positions, Sniping, and Clear weapon malfunction.

- Only two factors still were rated below 50% in *Current Capability*: Change weapons (rifle/pistol) and Throw grenades. Neither capability has been modeled so far (see Section 2.4.6), though survey participants consider that both are important to implement in TTES.

4.1.3 Discretionary Decisions

3. **TTES events: discretionary decisions**. What events should be included in the TTES scenarios and synthetic environment to aid in making decisions about responses to possible adversaries?

Potential Usefulness of Listed Factors for TTES Training

- Nine of the listed factors received calculated Total Group *Potential Usefulness* ratings of 90% or higher, placing them in the *critical*-to-include category.

	Potential Usefulness Rating		
Discretionary Decisions	**Total Group**	**Military**	**Civilians**
Snipers in area	**96.4**	95.7	100.0
Individual hostiles in area	**95.0**	94.8	96.0
Friendlies/Allied troops in area	**95.0**	94.8	96.0
Threatening weapon presentation	**94.3**	95.7	88.0
Hostages in area	**93.6**	93.9	92.0
Unknowns in area	**92.9**	93.0	92.0
Villagers/bystanders in area	**92.9**	92.2	96.0
Fleeing enemy	**92.1**	93.0	88.0
Enemy prisoners of war	**90.0**	90.4	88.0
Hostile crowds	**87.9**	88.7	84.0
Non-threatening wpn presentation	**87.9**	88.7	84.0
Wounded enemy	**87.9**	87.0	92.0
Enemies in Allied uniforms	**86.4**	87.0	84.0
***Potential* Overall TTES usefulness: Discretionary Decisions**	**95.2**	**95.3**	**95.0**

- The remaining four factors were rated better than 80% by the Total Group and also by both Military and Civilian groups separately, and should be considered *extremely important* to include in TTES.

- In 1994, this group of factors was rated 83.5% in average *Importance* for TTES. This year's still higher *Potential Usefulness* rating of 95.2% may indicate that, as modeling has improved, TTES users feel that it is even more important to include a reasonable range of situations and computer-controlled battlefield entities for decision-making training.

Current Capability of TTES to Emulate Listed Factors

- Every listed Discretionary Decision factor received a higher Total Group *Current Capability* rating in 1995 than in 1994.

- Greatest improvement (20 points or more difference) was noted for Individual hostiles, Friendlies/Allied troops, Unknowns, Villagers, and Fleeing enemies. Friendlies, Unknowns, and Villagers had not been modeled prior to the 1994 survey, so it is not surprising that between 68% and 75% improved capability was perceived in 1995. Individual hostiles already were modeled with reasonable realism in 1994, but still a 40% improvement in *Current Capability* is indicated by 1995 survey responses.

- Ratings of less than 50% were calculated for Enemy prisoners of war, Enemies in Allied uniforms, and Hostile crowds — computer-controlled entities for which no TTES modeling has been done so far.

	Current Capability Rating			
Discretionary Decisions	**Total Group**	**Military**	**Civilians**	**1994 Total Group**
Individual hostiles in area	**77.1**	74.8	88.0	**55.0**
Friendlies/Allied troops in area	**72.5**	71.0	80.0	**41.1**
Unknowns in area	**70.8**	69.0	80.0	**42.1**
Villagers/bystanders in area	**65.5**	65.6	65.0	**38.9**
Threatening weapon presentation	**61.1**	60.0	65.0	**52.6**
Fleeing enemy	**58.9**	54.7	75.0	**35.8**
Wounded enemy	**58.8**	56.9	65.0	**40.0**
Snipers in area	**57.0**	49.3	80.0	**45.0**
Non-threatening wpn presentation	**55.6**	55.7	55.0	**43.2**
Hostages in area	**54.4**	52.9	60.0	**37.9**
Enemy prisoners of war	**48.0**	45.5	55.0	**32.9**
Enemies in Allied uniforms	**47.5**	43.6	56.0	**35.6**
Hostile crowds	**45.3**	41.8	55.0	**41.1**
***Current* Overall TTES capability: Discretionary Decisions**	**70.0**	**70.0**	**70.0**	**41.3**

4.1.4 Mission Preview

4. **TTES use: mission preview**. Mission preview is a mission planning function for a specific area and military operation. No dynamic interactions with the environment or potential adversaries are needed. It is simply a virtual walk-through of the objective area. What capabilities should TTES provide for mission preview?

Potential Usefulness of Listed Factors for TTES Training

	Potential Usefulness Rating		
Mission Preview	**Total Group**	**Military**	**Civilians**
Visualize potential kill zones	**96.4**	96.5	96.0
Visualize obstacles and danger zones	**96.4**	96.5	96.0
Visualize approach and routes	**95.7**	95.7	96.0
Evaluate sectors of fire for defense/offense	**94.3**	94.8	92.0
Familiarize & retain familiarization	**94.3**	93.9	96.0
Evaluate courses of action	**94.1**	93.9	95.0
Locate supplementary/alternate positions for defense/offense	**93.6**	93.0	96.0
Solidify plan of action	**90.7**	91.3	88.0
***Potential* Overall TTES usefulness: Mission Preview**	**94.8**	**95.0**	**93.3**

- This category was not included in the 1994 survey, so no *Importance* rating is available from that year.

- Overall *Potential Usefulness* and all of the listed Mission Preview simulation capabilities were rated at better than 90% by the Total Group, and should be considered *critical* to include in TTES. The ability to preview missions is expected to be a very useful function for TTES.

Current Capability of TTES to Emulate Listed Factors

- The Mission Preview category of simulation factors was not included in the 1994 survey, so a perceived level of improvement in the past year cannot be determined.

	Current Capability Rating		
Mission Preview	**Total Group**	**Military**	**Civilians**
Visualize approach and routes	**76.8**	74.0	88.0
Visualize obstacles and danger zones	**75.8**	76.0	75.0
Familiarize & retain familiarization	**74.2**	72.6	80.0
Evaluate courses of action	**73.9**	73.0	80.0
Visualize potential kill zones	**73.3**	73.0	75.0
Locate supplementary/alternate positions for defense/offense	**72.7**	72.2	75.0
Solidify plan of action	**71.7**	73.0	65.0
Evaluate sectors of fire for defense/offense	**69.6**	67.4	80.0
***Current* Overall TTES capability: Mission Preview**	**72.6**	**75.0**	**60.0**

- All factors in this category received relatively high ratings from the Total Group, indicating that TTES already is considered reasonably capable for previewing missions.

4.1.5 Mission Rehearsal

5. **TTES use: mission rehearsal**. Mission rehearsal is a mission preparation function — conducting a simulated operation or tactical sequence in a specific dynamic environment. Hostile and neutral forces are tailored to the expected adversary profile. The goals are to validate a concept of operations and to assess the scenario and potential outcome. What capabilities should TTES provide for mission rehearsal?

Potential Usefulness of Listed Factors for TTES Training

- The Mission Rehearsal category of simulation factors was not included in the 1994 survey, so no *Importance* rating is available from that year.

- All of the factors included in the Mission Rehearsal category are considered *critical* to include for TTES, with Overall and individual factor *Potential Usefulness* ratings all over 90%. As with Mission Preview, the Mission Rehearsal function is expected to be very useful for trainees using TTES.

Mission Rehearsal	Potential Usefulness Rating		
	Total Group	Military	Civilians
Evaluate courses of action	**96.3**	96.4	96.0
React to hostile presence	**95.6**	96.4	92.0
Evaluate plan of action	**95.6**	95.5	96.0
Cross danger point	**94.8**	94.5	96.0
Deal with threat point	**94.8**	94.5	96.0
Immediate action reaction to ambush	**93.3**	93.6	92.0
React to neutral presence	**93.3**	93.6	92.0
Immediate action reaction to sniper fire	**93.3**	92.7	96.0
Evaluate movement techniques	**93.3**	92.7	96.0
Compare simulation outcomes to expectation	**92.6**	92.7	92.0
Solidify plan of action	**92.6**	91.8	96.0
Move to supplementary/alternate positions	**91.1**	90.0	96.0
***Potential* Overall TTES usefulness: Mission Rehearsal**	**93.9**	**94.7**	**90.0**

Current Capability of TTES to Emulate Listed Factors

- The Mission Rehearsal category of simulation factors was not included in the 1994 survey, so the level of improvement in the past year cannot be determined.

Mission Rehearsal	Current Capability Rating		
	Total Group	Military	Civilians
React to hostile presence	**73.6**	71.4	85.0
React to neutral presence	**72.5**	69.0	90.0
Evaluate courses of action	**69.0**	67.5	75.0
Deal with threat point	**68.6**	65.9	80.0
Evaluate plan of action	**67.6**	65.9	75.0
Solidify plan of action	**67.6**	65.9	75.0
Move to supplementary/alternate positions	**67.6**	62.4	90.0
Compare simulation outcomes to expectation	**67.0**	62.5	85.0
Evaluate movement techniques	**66.7**	62.4	85.0
Cross danger point	**62.7**	60.0	75.0
Immediate action reaction to ambush	**53.3**	50.0	65.0
Immediate action reaction to sniper fire	**50.0**	46.3	65.0
***Current* Overall TTES capability: Mission Rehearsal**	**73.0**	**72.9**	**73.3**

- All factors in this category received Total Group *Current Capability* ratings of 50% or better, indicating that TTES is considered at least somewhat capable now for Mission Rehearsal — about as well developed as the Mission Preview category of simulation factors.

4.2 TTES OBJECTS, SITUATIONS, AND EVENTS

Section B of the 1995 survey concerned the *details* that are needed for realistic modeling of the training situations and events included in the first section's five categories. Questions relate to (1) environments (urban, village, etc.), (2) environmental effects (weapon impacts, fires, fog, etc.), and (3) general objects (animals, trees, rocks, etc.) that might be included for realism. Questions also were asked concerning (4) simulated humans, (5) weapons, and (6) sounds. The questions asked and *Potential Usefulness* and *Current Capability* results are provided below. In addition, ratings for required *Realism Levels* are included for this section of the survey.

4.2.1 Environments

1. **Environments to simulate in TTES.** What natural and man-made environments should be simulated in the TTES synthetic environment?

Potential Usefulness of Listed Factors for TTES Training

- All but two of the 10 listed TTES Environments are rated by the Total Group at 90% or more in *Potential Usefulness*, placing them in the *critical* to include category.

	Potential Usefulness Rating		
TTES Environments	**Total Group**	**Military**	**Civilians**
Urban: city	**97.0**	96.4	100.0
Jungle	**96.3**	95.5	100.0
Urban: village	**95.6**	94.5	100.0
Desert	**95.6**	94.5	100.0
Ships, submarines	**94.1**	93.6	96.0
Farmland	**91.5**	90.0	100.0
Arctic/winter	**91.1**	90.9	92.0
Federal buildings	**90.4**	88.2	100.0
NBC environments	**87.2**	85.5	100.0
Prisons	**86.7**	84.5	96.0
***Potential* Overall TTES usefulness: Environments**	**92.0**	**90.6**	**100.0**
Required Realism Level	**73.8**	**73.3**	**76.0**

- The Urban: city environment was perceived by the Total Group as TTES's potentially most useful environment (97.0%), with Jungle, Urban: village, and Desert close behind.

- Inclusion of Ships, submarines in the top five factors is surprising; this factor rated last in 1994. No explanation is obvious.

- Extremely high ratings were assigned by the five civilians (with the Overall Environments category rated at 100%). Law enforcement officers may anticipate the need for training under a very wide range of conditions.

- The average calculated 1994 *Importance* rating for this category was 81.9%. The 92.0% *Potential Usefulness* rating given by the Total Group in 1995 indicates that this latest group of TTES evaluators has even stronger expectations that TTES will be useful for training for numerous kinds of situations.

- The Total Group's average rating for the required *Realism Level* of simulated Environments, 73.8%, suggests that Exact replication is not necessary; Good replication (hard to tell it is not real) should be seen as adequate by potential TTES trainees.

Current Capability of TTES to Emulate Listed Factors

- All of the listed Environments received 1995 *Current Capability* ratings of better than 50%, with the Overall Environments category rated by the Total Group at over 74% of potential.

	Current Capability Rating			
TTES Environments	**Total Group**	**Military**	**Civilians**	**1994 Total Group**
Urban: city	**81.5**	84.5	65.0	**68.0**
Urban: village	**81.2**	83.1	75.0	**61.0**
Desert	**70.9**	67.5	80.0	**47.8**
Farmland	**69.1**	65.0	80.0	**51.6**
Jungle	**64.0**	57.1	80.0	**45.6**
Arctic/winter	**63.6**	60.0	73.3	**46.7**
Federal buildings	**63.1**	64.0	60.0	**53.3**
NBC environments	**62.0**	52.5	100.0	**41.1**
Prisons	**56.4**	57.5	53.3	**48.9**
Ships, submarines	**56.4**	57.5	53.3	**44.4**
***Current* Overall TTES capability: Environments**	**74.1**	**74.7**	**70.0**	**54.3**

- The *Current Capability* ratings provided for all of the individual Environments factors by the 1995 survey respondents were surprisingly high, considering that only an Urban: village environment has been implemented in the simulations so far. The excellence of this village simulation must have indicated to the evaluators that similarly good representations will be available for all of the listed Environments.

- This Overall Environments category rating has jumped nearly 20 points in the past year, moving from a 54.3% *Current Capability* rating in 1994 to 74.1% in 1995 — representing a perceived 36% improvement.

4.2.2 Environmental Effects

2. **Environmental effects.** What realistic environmental (physical) occurrences in the engagement area will influence TTES trainees to react tactically to the changing scenarios?

Potential Usefulness of Listed Factors for TTES Training

- All of the listed Environmental Effects were rated at 90% or better in *Potential Usefulness*, placing them all in the *critical* classification.

- All five Civilians gave a rating of 1 to all of the listed effects, resulting in calculated ratings of 100% for each. Law enforcement officers probably expect that they will be required to carry out their duties under a wide variety of conditions and circumstances, during long careers, and should be trained for the effects of all of these.

	Potential Usefulness Rating		
TTES Environmental Effects	**Total Group**	**Military**	**Civilians**
Reduced visibility (fog, rain)	**95.8**	95.0	100.0
Small arms projectile impacts	**95.6**	94.5	100.0
Automatic weapons projectile impacts	**95.6**	94.5	100.0
Pistol projectile impacts	**94.6**	93.3	100.0
Grenade impacts	**92.5**	91.0	100.0
Mortar impacts	**91.7**	90.0	100.0
Shoulder-launched rocket impacts	**91.7**	90.0	100.0
Structure fires	**90.4**	88.0	100.0
***Potential* Overall TTES usefulness: Environmental Effects**	**92.6**	**90.7**	**100.0**
Required Realism Level	**68.5**	**67.6**	**72.0**

- The 1994 calculated average Total Group *Importance* rating for the Environmental Effects category was 83.7%. The related *Potential Usefulness* rating of 92.6% in 1995 represents a 10% increase in perceived usefulness of these factors, probably not a significant change in perceptions considering the small sample sizes.

- The Total Group's average rating for the required *Realism Level*, 68.5%, indicates that Good replication (hard to tell it is not real) is adequate for Environmental Effects.

Current Capability of TTES to Emulate Listed Factors

	Current Capability Rating			
TTES Environmental Effects	**Total Group**	**Military**	**Civilians**	**1994 Total Group**
Small arms projectile impacts	**57.5**	59.0	50.0	**43.0**
Automatic weapons projectile impacts	**44.3**	40.0	55.0	**40.0**
Pistol projectile impacts	**43.1**	40.0	50.0	**37.9**
Structure fires	**37.8**	37.1	40.0	**38.9**
Reduced visibility (fog, rain)	**36.0**	37.1	33.3	**36.7**
Grenade impacts	**33.3**	33.3	33.3	**34.4**
Mortar impacts	**32.0**	31.4	33.3	**34.4**
Shoulder-launched rocket impacts	**32.0**	31.4	33.3	**35.6**
***Current* Overall TTES capability: Environmental Effects**	**54.1**	**58.5**	**40.0**	**36.0**

- While the Environments category was rated relatively high in *Current Capability*, the Environmental Effects category was rated much lower. All but one factor (Small arms projectile impacts) received calculated ratings of less than 50%. More development effort

probably should be expended in this area, considering the very high *Potential Usefulness* ratings given to this category.

- Structure fires, Reduced visibility, Grenade impacts, Mortar impacts, and Shoulder-launched rocket impacts (none of which have been modeled for TTES at present) received slightly higher *Current Capability* ratings in 1994 than in 1995, though the differences are not significant.

- Although still among the lowest-rated categories in *Current Capability*, the Environmental Effects Total Group rating has soared in the past year, moving from 36.0% to 54.1%, a perceived improvement of 50%.

4.2.3 General Objects

3. **General objects in TTES environment.** What realistic general objects should be present in the TTES synthetic environment to add realism to training situations?

Potential Usefulness of Listed Factors for TTES Training

- Only Animals were rated at less than 90% in *Potential Usefulness* by the Total Group, placing that factor in the *extremely-important*-to-include classification and all the rest in the *critical*-to-include classification.

	Potential Usefulness Rating		
TTES General Objects	**Total Group**	**Military**	**Civilians**
Traps, trip wires, mines	**98.6**	98.3	100.0
Incoming fire	**98.6**	98.3	100.0
Buildings	**98.6**	98.3	100.0
Doors & windows	**98.6**	98.3	100.0
Roads	**97.9**	97.4	100.0
Target hits	**97.1**	96.5	100.0
Furniture	**97.0**	96.4	100.0
Barbed wire/concertina	**96.4**	97.4	92.0
Explosions	**96.4**	97.4	92.0
Trees, bushes (obstacles & cover)	**96.4**	95.7	100.0
Rocks (obstacles & cover)	**96.4**	95.7	100.0
Vehicles	**96.4**	95.7	100.0
Burning objects	**95.6**	95.5	96.0
Debris	**95.6**	94.5	100.0
Rivers, lakes, etc.	**95.0**	94.8	96.0
Bridges	**95.0**	94.8	96.0
Rubble	**93.3**	93.6	92.0
Animals	**80.7**	77.4	96.0
***Potential* Overall TTES usefulness: General Objects**	**96.8**	**97.3**	**95.0**
Required Realism Level	**79.3**	**78.2**	**84.0**

- In 1994, General Objects received a calculated Total Group average *Importance* rating of 84.9%, compared with a 96.8% Overall *Potential Usefulness* rating in 1995, about a 15% increase.

- The Total Group's average rating for the required *Realism Level* of General Objects, 79.3%, is the highest for any category, barely below the arbitrary cutoff for Exact replication. Obviously, very good emulation is desired for simulated objects.

Current Capability of TTES to Emulate Listed Factors

- Eight of the listed General Objects were rated at better than 50% in *Current Capability* by the Total Group.

	Current Capability Rating			
TTES General Objects	**Total Group**	**Military**	**Civilians**	**1994 Total Group**
Buildings	**82.4**	81.8	86.7	**63.0**
Roads	**78.2**	78.9	73.3	**60.0**
Doors & windows	**74.8**	74.0	80.0	**62.0**
Trees, bushes (obstacles & cover)	**71.4**	71.1	73.3	**48.0**
Target hits	**62.4**	61.5	65.0	**49.0**
Rocks (obstacles & cover)	**60.0**	58.0	70.0	**38.9**
Rivers, lakes, etc.	**52.5**	46.7	70.0	**43.3**
Bridges	**52.5**	46.7	70.0	**46.7**
Incoming fire	**48.3**	49.1	40.0	**36.8**
Explosions	**43.3**	44.0	40.0	**38.9**
Burning objects	**43.3**	44.0	40.0	**41.1**
Vehicles	**42.9**	44.0	40.0	**58.0**
Animals	**40.0**	40.0	40.0	**36.7**
Barbed wire/concertina	**40.0**	40.0	40.0	**38.9**
Debris	**40.0**	40.0	40.0	**36.7**
Furniture	**38.2**	40.0	30.0	**40.0**
Rubble	**37.1**	36.7	40.0	**43.2**
Traps, trip wires, mines	**36.7**	36.0	40.0	**38.9**
***Current* Overall TTES capability: General Objects**	**64.4**	**66.7**	**53.3**	**42.9**

- The representation of Buildings was top rated at 82.4% — the highest Total Group *Current Capability* rating for any of the individual factors included in any simulation category. TTES developers obviously are perceived as having done an admirable job of emulating realistic buildings.

- Most of the listed General Objects still need improvement in simulation fidelity, with 10 of the 18 rated below 50% in *Current Capability* by the Total Group.

- The Total Group's Overall rating for the simulation of General Objects has gone from 42.9% to 64.4% in the past year, an increase of 50%.

4.2.4 Simulated Humans

4. **Simulated humans in TTES environment**. What humans should be present in the TTES synthetic environment for trainees to interact with, as they go through training situations?

Potential Usefulness of Listed Factors for TTES Training

- The Simulated Humans category of simulation factors was rated very high in *Potential Usefulness* by the Total Group, at 96.4%.

	Potential Usefulness Rating		
TTES Simulated Humans	**Total Group**	**Military**	**Civilians**
Hostiles	**97.9**	97.4	100.0
Snipers	**97.1**	96.5	100.0
Friendlies	**95.7**	94.8	100.0
Villagers/innocent bystanders	**95.0**	93.9	100.0
Hostages	**95.0**	93.9	100.0
Unknowns	**94.3**	93.0	100.0
***Potential* Overall TTES usefulness: Simulated Humans**	**96.4**	**95.6**	**100.0**
Required Realism Level	**74.8**	**73.6**	**80.0**

- Although Hostiles and Snipers ranked at the top of the *Potential Usefulness* list, differences between the ratings of these two and those of the remaining four listed types of humans are not significant.

- Each of the five Civilians gave a rating of 1 to all five types of listed Simulated Humans, resulting in calculated 100% ratings across the board.

- The Simulated Humans category ranked highest in the 1994 survey, with a calculated average *Importance* rating of 92.7%. The 1995 96.4% Overall *Potential Usefulness* rating, while higher, does not represent a significant difference (only 4%) — but probably indicates that, as modeling has improved, TTES users still feel that including a reasonable range of computer-controlled battlefield entities is very important.

- A Total Group required *Realism Level* rating of 74.8% for Simulated Humans indicates that Good replication (hard to tell it is not real) should be seen as adequate by potential TTES trainees. The rating by Civilians is on the border of suggesting that, for law enforcement, Exact emulation of humans may be desired.

Current Capability of TTES to Emulate Listed Factors

	Current Capability Rating			
TTES Simulated Humans	**Total Group**	**Military**	**Civilians**	**1994 Total Group**
Hostiles	**76.3**	73.9	90.0	**58.9**
Friendlies	**68.7**	64.2	90.0	**44.4**
Villagers/innocent bystanders	**67.6**	62.4	90.0	**44.4**
Unknowns	**59.0**	51.3	90.0	**43.3**
Snipers	**53.8**	41.7	90.0	**48.9**
Hostages	**46.2**	41.8	70.0	**50.0**
***Current* Overall TTES capability: Simulated Humans**	**69.5**	**67.8**	**80.0**	**42.9**

- With the exception of Hostages (46.2%), the TTES evaluators rated all of the Simulated Humans at better than 50% in *Current Capability*.

- Hostiles still are considered the best modeled humans in 1995, as in 1994. However, based on the ratings from the two years, about a 30% improvement is perceived as a result of the past year's development efforts.

- Modeling of Friendlies (the other member of the two-man squad carrying out each scenario) and Villagers is new in 1995. Thus it is not surprising that the ratings indicate major improvements in simulation of these humans: more than 50% for each.

- The group of five Civilians was especially positive about current modeling of Simulated Humans in TTES, with all humans except Hostages rated at 90% and an Overall rating of 80% for the category.

- Overall, modeling of Simulated Humans is rated more than 25 points higher in 1995 than in 1994, a perceived improvement of over 60%.

4.2.5 Weapons

5. **Weapons in TTES environment**. What weapon systems should be present in the TTES synthetic environment for trainees to practice using and to interact with?

Potential Usefulness of Listed Factors for TTES Training

	Potential Usefulness Rating		
TTES Weapons	**Total Group**	**Military**	**Civilians**
Assault rifles	**97.9**	97.4	100.0
Squad automatic weapons	**97.8**	97.4	100.0
Pistols	**97.1**	96.5	100.0
Submachine guns	**97.0**	96.4	100.0
Machine guns	**96.2**	95.5	100.0
Shoulder-launched missiles/rockets	**91.9**	91.3	95.0
Grenades	**89.6**	87.8	100.0
Flashbangs	**87.1**	84.3	100.0
Satchel charges	**86.9**	84.5	100.0
Mortars	**85.4**	83.6	95.0
Explosive charges	**83.7**	81.7	95.0
Knives	**75.4**	73.6	85.0
***Potential* Overall TTES usefulness: Weapons**	**91.0**	**90.6**	**93.3**
Required Realism Level	**78.5**	**76.4**	**88.0**

- Total Group ratings of more than 90% were calculated for the *Potential Usefulness* of six Weapons: Assault rifles, Squad automatic weapons, Pistols, Submachine guns, Machine guns, and Shoulder-launched missiles/rockets. Modeling of these falls into the *critical* classification.

Grenades, while technically below the 90% cutoff with 89.6%, probably also belong in that classification.

- Knives, rated at 75.4% by the Total Group, are in the *important*-to-include classification, while the four remaining listed Weapons (ratings between 80 and 90%) should be considered *extremely important.*

- The five Civilians generally considered all of the listed weapons more *Potentially Useful* than did the Military respondents, but they, too, rated knives at the bottom.

- Weapons received an overall 81.8% calculated *Importance* rating in 1994 and a 91.0% *Potential Usefulness* rating in 1995, indicating about a 10% difference in the perceived importance of including a variety of Weapons in TTES.

- Total Group average rating for the required *Realism Level* of weapons, 78.5%, is the second highest (after General Objects) among all Section B categories. This indicates that, while Exact replication may not be necessary; Good replication (hard to tell it is not real) is very important for this category. The group of five Civilians rated weapons as needing the greatest realism of any category, and propose that they require Exact replication.

Current Capability of TTES to Emulate Listed Factors

- Modeling of only the Assault rile approaches a reasonable level of *Current Capability* (78.4%). This weapon is perceived as being about 30% more realistic in 1995 than it was in 1994.

	Current Capability Rating			
TTES Weapons	**Total Group**	**Military**	**Civilians**	**1994 Total Group**
Assault rifles	**78.4**	76.2	90.0	**58.9**
Submachine guns	**42.2**	34.3	70.0	**35.3**
Machine guns	**40.0**	42.5	30.0	**38.9**
Knives	**37.8**	28.6	70.0	**31.1**
Pistols	**34.0**	35.0	30.0	**38.8**
Explosive charges	**32.5**	31.4	40.0	**34.1**
Flashbangs	**32.5**	31.4	40.0	**33.3**
Squad automatic weapons	**32.5**	31.4	40.0	**37.8**
Shoulder-launched missiles/rockets	**32.5**	31.4	40.0	**34.4**
Mortars	**30.0**	28.6	40.0	**32.9**
Grenades	**30.0**	28.6	40.0	**34.4**
Satchel charges	**30.0**	28.6	40.0	**33.3**
***Current* Overall TTES capability: Weapons**	**63.2**	**67.1**	**30.0**	**33.3**

- The remaining weapons (none of which are available in TTES at present) are rated very low in *Current Capability*, as they were in 1994.

- The five Civilians rated the *Current Capability* of nearly all of the weapons higher than did the Military group but, surprisingly, gave a much lower Overall rating for the category.

- In spite of the low ratings assigned to most of the listed weapons, the Total Group's Overall Weapons *Current Capability* rating of 63.2% is quite respectable, especially when compared with the 33.3% value assigned in 1994 (a 90% perceived improvement over the year).

4.2.6 Sounds

6.	**Sounds in TTES environment**. What audible sounds should be present in the TTES synthetic environment to add realism to training situations?

Potential Usefulness of Listed Factors for TTES Training

- This is the first year when any battlefield Sounds were emulated in TTES demonstrations. Verbal communications between the two members of the squad were implemented in 1995 via microphones and audio headsets.

	Potential Usefulness Rating		
TTES Sounds	**Total Group**	**Military**	**Civilians**
Normal conversations	**96.3**	96.4	96.0
Verbal commands	**95.6**	97.3	88.0
Explosions	**95.0**	93.9	100.0
Excited chatter	**94.8**	93.9	100.0
Weapon functioning	**94.3**	93.0	100.0
Footsteps	**91.9**	90.9	96.0
Trees & branches snapping	**88.1**	86.4	96.0
***Potential* Overall TTES usefulness: Sounds**	**98.0**	**98.8**	**95.0**
Required Realism Level	**76.9**	**76.2**	**80.0**

- With the exception of Trees & branches snapping (88.1% and considered *extremely important* to include), all of the listed Sounds are in the *critical* classification with Total Group ratings over 90% in *Potential Usefulness*.

- Sounds, with a calculated average rating of 86.7% in 1994, at that time ranked second in *Importance* only to Simulated Humans. This year's rating of 98.0% moves the Sounds category ahead of the Simulated Humans category (96.4%) in *Potential Usefulness* for TTES training.

- The Total Group's average rating for required *Realism Level*, 76.9%, suggests that Exact replication of Sounds is not quite necessary; Good replication (hard to tell it is not real) probably will be seen as adequate by most TTES trainees.

Current Capability of TTES to Emulate Listed Factors

- Even though the only Sounds implemented so far are verbal communications, all of the listed types were rated much higher in *Current Capability* in 1995 than in 1994. Apparently the ability to communicate during training exercises has indicated to TTES evaluators that other Sounds now also are possible or will be soon.

TTES Sounds	Current Capability Rating			
	Total Group	Military	Civilians	1994 Total Group
Normal conversations	**66.3**	67.5	60.0	**32.2**
Verbal commands	**58.6**	58.2	60.0	**32.2**
Weapon functioning	**54.7**	51.4	64.0	**35.6**
Footsteps	**50.7**	48.3	60.0	**32.2**
Explosions	**45.0**	40.0	60.0	**33.3**
Excited chatter	**41.3**	36.4	55.0	**31.1**
Trees & branches snapping	**36.4**	27.5	60.0	**33.3**
***Current* Overall TTES capability: Sounds**	**60.0**	**65.3**	**33.3**	**30.7**

- Normal conversations, Verbal commands, Weapon functioning, and Footsteps received *Current Capability* ratings of 50% or better.

- The remaining three Sounds have not been implemented in TTES and are rated much lower.

- The five Civilians gave reasonably high *Current Capability* ratings to the individual listed Sounds (55 to 64%), but only a 33.3% Overall rating for the category as a whole.

- As noted, 1995 was the first year when any battlefield Sounds were simulated. Thus a perceived *Current Capability* improvement of 95% from the 1994 ratings is not surprising.

- The great importance the subject matter experts have assigned to Sounds and the category's relatively low *Current Capability* rating indicate that this is an area that TTES developers should stress.

4.3 TRAINEE AND ADVERSARY MOVEMENTS AND POSITIONS

Section C of the 1995 survey concerns the level of detail needed for both realistic instruction of *trainees* and realistic emulation of *simulated adversaries* in tactical situations. Questions were asked related to (1) coordinated tactical movements, (2) individual body movements, (3) firing positions, (4) arm and hand movements, (5) head movements, and (6) eye movements.

For each question, survey participants were asked to provide two *Potential Usefulness* ratings: one for how useful it will be that the *Trainee* have that capability, and a second for how useful it will be that *Adversaries* are simulated at this level of detail. Respondents also were asked for two *Current Capability* ratings, for both *Trainee* and *Adversary* capabilities.

For every category, Overall *Potential Usefulness* ratings for the listed factors were higher for Trainees than for simulated Adversaries. The experts who participated in this survey apparently feel that some deviation from real-world behavior by simulated humans may be acceptable, but that Trainees must be able to carry out typical combat tasks as realistically as possible if TTES is to be accepted.

4.3.1 Coordinated Tactics

1.a. **Trainee coordinated tactical movements**. What coordinated tactical movements should TTES allow trainees to perform in the simulator, as they go through simulated training situations?

Potential Usefulness of Listed Factors for TTES Training

- The survey respondents' *Potential Usefulness* ratings indicated that all but one of the listed Coordinated Tactical Movements are *critical* for Trainees.

	Potential Usefulness Rating for Trainee		
Coordinated Tactical Movements	**Total Group**	**Military**	**Civilian**
Enter room	**99.3**	99.1	100.0
Enter building	**98.6**	98.3	100.0
Patrol	**98.5**	98.2	100.0
Enter ambush site	**97.0**	96.4	100.0
Fire & maneuver	**96.4**	95.7	100.0
Rush (fire & move)	**96.2**	95.2	100.0
Cover moving buddies	**94.3**	96.5	84.0
Use hand & arm signals	**93.6**	93.0	96.0
Enter vehicle	**91.2**	89.5	100.0
Control crowds/marshal people	**90.0**	88.2	100.0
Pick up/carry injured buddy	**80.8**	78.1	95.0
***Potential* Overall TTES usefulness: Tactical Movements**	**96.2**	**95.3**	**100.0**

- Only Pick/carry injured buddy was rated less than 90% in *Potential Usefulness* for the Trainee, and even that capability fell into the *extremely-important*-to-include classification.

- Coordinated Tactics were considered quite important by the five-man Civilian subgroup, which gave a 100% Overall *Potential Usefulness* rating to this category for Trainees.

- In 1994, this category received an Overall *Importance* rating of 85.2%. The *Potential Usefulness* jump to 96.2% in 1995 represents a perceived increase in importance/usefulness of about 12%.

Current Capability of TTES to Emulate Listed Factors

- Enter buildings, Enter rooms, Patrol, and Cover moving buddies all were rated relatively highly (60 to 70%) in *Current Capability* in 1995. Fire & maneuver also was rated at better than 50%.

- The six remaining Coordinated Tactical Movements listed in this category were rated below 50%, with four (Pickup/carry injured buddy, Use hand & arm signals, Enter vehicle, and Control crowds/marshal people) rated very low in *Current Capability* (among the lowest of any factors included on the questionnaire). This is not surprising, since none of these currently have been implemented in TTES, and it is hard even to envision how they might be included in TTES scenarios.

Coordinated Tactical Movements	Current Capability Rating for Trainee			
	Total Group	Military	Civilian	1994 Total Group
Enter building	**70.0**	72.4	60.0	**57.3**
Enter room	**68.9**	70.9	60.0	**57.3**
Patrol	**61.1**	58.6	70.0	**45.3**
Cover moving buddies	**61.0**	57.5	75.0	**31.4**
Fire & maneuver	**52.7**	52.9	52.0	**38.7**
Rush (fire & move)	**49.0**	48.0	52.0	**37.1**
Enter ambush site	**44.0**	38.2	60.0	**41.3**
Pick up/carry injured buddy	**29.3**	30.0	26.7	**28.6**
Use hand & arm signals	**28.2**	27.1	33.3	**32.9**
Enter vehicle	**26.2**	26.0	26.7	**32.9**
Control crowds/marshal people	**26.2**	26.0	26.7	**30.0**
***Current* Overall TTES capability: Tactical Movements**	**58.0**	**60.0**	**50.0**	**40.0**

- In spite of the preponderance of poor *Current Capability* ratings for Coordinated Tactical Movements, significant improvement in the last year is indicated by comparing the 1994 and 1995 results; there is about a 45% difference in the two years' Overall ratings.

1.b. **Simulated adversary coordinated tactical movements.** What coordinated tactical movements should TTES simulate for hostiles, neutrals, and friendlies, for various training situations?

Potential Usefulness of Listed Factors for TTES Training

Coordinated Tactical Movements	Potential Usefulness Rating for Adversary		
	Total Group	Military	Civilian
Enter room	**96.2**	98.2	85.0
Enter building	**95.4**	97.3	85.0
Enter ambush site	**95.0**	97.1	80.0
Rush (fire & move)	**95.0**	96.0	90.0
Fire & maneuver	**94.6**	96.4	85.0
Patrol	**93.3**	95.2	80.0
Cover moving buddies	**92.3**	93.6	85.0
Use hand & arm signals	**90.0**	91.4	80.0
Enter vehicle	**89.6**	91.0	80.0
Pick up/carry injured buddy	**87.0**	88.0	80.0
Control crowds/marshal people	**82.5**	82.9	80.0
***Potential* Overall TTES usefulness: Tactical Movements**	**94.7**	**97.3**	**85.0**

- Computer-controlled Adversaries are expected by the Total Group to display nearly the same level of Coordinated Tactical Movements as Trainees are permitted in TTES: 94.7% Overall *Potential Usefulness* to the Trainee's 96.2%.

- As with Trainees, Pickup/carry injured buddy and Control crowds/marshal people were rated lowest in *Potential Usefulness* for Adversaries, though still at 87.0 and 82.5%, respectively.

- Civilians consistently rated the *Potential Usefulness* of the listed Tactical Movements as lower for Adversaries than for Trainees.

- In 1994 this category received an *Importance* rating of only 74.6%, raising concerns that military personnel may be underestimating the capabilities of their real-world adversaries and thus proposing that their actions only need be modeled in a simplistic manner. The 1995 Overall Coordinated Tactical Movements *Potential Usefulness* rating for Adversaries of 94.7% (more than a 25% increase) alleviates these concerns.

Current Capability of TTES to Emulate Listed Factors

- TTES Adversaries are seen by the Total Group as more than 50% capable for only three types of Tactical Movements: Patrol, Enter room, and Enter building.

	Current Capability Rating for Adversary			
Coordinated Tactical Movements	**Total Group**	**Military**	**Civilian**	**1994 Total Group**
Patrol	**60.0**	58.6	70.0	**45.3**
Enter room	**57.9**	60.0	46.7	**57.3**
Enter building	**56.8**	58.8	46.7	**57.3**
Rush (fire & move)	**44.0**	44.6	40.0	**37.1**
Cover moving buddies	**43.8**	36.9	73.3	**31.4**
Enter ambush site	**43.1**	40.0	60.0	**41.3**
Fire & maneuver	**42.7**	43.1	40.0	**38.7**
Pick up/carry injured buddy	**34.5**	35.6	30.0	**28.6**
Enter vehicle	**33.3**	34.0	30.0	**32.9**
Use hand & arm signals	**31.4**	30.0	40.0	**32.9**
Control crowds/marshal people	**30.0**	30.0	30.0	**30.0**
***Current* Overall TTES capability: Tactical Movements**	**47.1**	**49.1**	**40.0**	**40.0**

- *Current Capability* ratings of less than 50% were calculated for the remaining eight of the 11 listed movements. The same movements considered unsatisfactory for Trainees also generally are judged as unsatisfactory for the simulated Adversaries.

- In general, the individual ratings indicate that little progress has been made in simulation of these Coordinated Tactical Movements for Adversaries over the past year — with the exception of the ability to Patrol.

- While about an 18% improvement can be inferred from the 1995 Overall category ratings when compared with 1994, the 47.1% *Current Capability* value calculated for Adversary Coordinated Tactical Movements indicates that major improvements in realism are needed. This category ranked lowest of all in perceived capability.

4.3.2 Body Movements

2.a. **Individual trainee body movements.** What tactically correct whole-body movements should TTES allow trainees to perform in the simulator?

Potential Usefulness of Listed Factors for TTES Training

- All listed Individual Body Movements were rated at better than 90% in *Potential Usefulness* for Trainees. Each of these capabilities must be considered *critical* to include in TTES for Trainees to use as appropriate in training scenarios.

	Potential Usefulness Rating for Trainee		
Individual Body Movements	**Total Group**	**Military**	**Civilian**
Run	**97.8**	99.1	92.0
Walk forwards	**97.1**	98.3	92.0
Walk backwards	**97.1**	98.3	92.0
Stand up	**97.0**	98.2	92.0
Lean over	**96.9**	98.1	92.0
Duck	**96.9**	98.1	92.0
Jump	**96.9**	98.1	92.0
Climb/crawl over obstacles	**96.9**	98.1	92.0
Dive behind cover	**96.8**	98.1	90.0
Kneel down	**96.4**	97.4	92.0
Lie down on front	**96.4**	97.4	92.0
Rotate body	**96.4**	97.4	92.0
Crawl	**96.3**	97.4	90.0
Roll right & left	**95.4**	96.2	92.0
Hit & roll	**94.6**	95.2	92.0
Lie down on back	**93.1**	93.3	92.0
Squat/duck walk	**92.3**	92.4	92.0
***Potential* Overall TTES usefulness: Body Movements**	**95.2**	**96.5**	**90.0**

- An *Importance* rating of 88.0 was calculated for this category in 1994. While the 95.2% rating calculated for *Potential Usefulness* in 1995 is higher, it represents less than 10% change in perceived importance/usefulness over the past year.

Current Capability of TTES to Emulate Listed Factors

- The Total Group of TTES evaluators gave *Current Capability* ratings of better than 50% to 10 of the17 listed Individual Body Movements for Trainees, with all of these 10 apparently much improved over the past year.

	Current Capability Rating for Trainee			
Individual Body Movements	Total Group	Military	Civilian	1994 Total Group
Stand up	**77.5**	78.0	75.0	**62.5**
Kneel down	**75.4**	74.5	80.0	**58.8**
Walk backwards	**69.6**	70.5	65.0	**56.3**
Run	**67.3**	71.1	50.0	**47.5**
Rotate body	**67.3**	67.8	65.0	**43.8**
Walk forwards	**67.2**	67.6	65.0	**53.8**
Squat/duck walk	**65.3**	65.0	66.7	**41.3**
Lie down on front	**61.9**	58.8	75.0	**55.0**
Duck	**61.1**	61.3	60.0	**52.5**
Lean over	**61.1**	57.1	75.0	**43.8**
Crawl	**47.8**	48.0	46.7	**33.3**
Roll right & left	**43.8**	40.0	60.0	**37.3**
Lie down on back	**38.7**	33.3	60.0	**40.0**
Hit & roll	**37.3**	31.7	60.0	**33.3**
Jump	**32.5**	26.7	50.0	**33.3**
Dive behind cover	**31.4**	27.3	46.7	**33.3**
Climb/crawl over obstacles	**29.2**	30.0	26.7	**32.9**
***Current* Overall TTES capability: Body Movements**	**60.0**	**61.3**	**53.3**	**44.6**

- Most of the remaining seven Body Movements, rated between 47.8 and 29.2% in 1995, showed little or no improvement in the past year.

- The Overall rating for Trainee Body Movements, however, was significantly greater in 1995 than in 1994, indicating more than 30% improvement in *Current Capability*. Thus, while potential TTES users still are dissatisfied with their ability to move freely in TTES, they are less unhappy than they were a year ago.

2.b. **Simulated adversary movements**. What whole-body movements should TTES simulate for hostiles, neutrals, and friendlies, as trainees encounter them during training situations?

Potential Usefulness of Listed Factors for TTES Training

- While a slightly lower Overall rating is given by the Total Group for the *Potential Usefulness* of these Body Movements for the Adversary than for Trainees, in general the evaluators indicated that they expect the entities they encounter in TTES to display the same human capabilities as they themselves have — that is, the computer-controlled simulated humans should be as "real" as possible.

	Potential Usefulness Rating for Adversary		
Individual Body Movements	Total Group	Military	Civilian
Stand up	**96.4**	98.3	88.0
Walk forwards	**96.4**	98.3	88.0
Walk backwards	**96.4**	98.3	88.0
Kneel down	**96.3**	98.2	88.0
Run	**96.3**	98.2	88.0
Crawl	**95.7**	97.4	88.0
Climb/crawl over obstacles	**95.4**	97.1	88.0
Lie down on front	**95.0**	96.5	88.0
Roll right & left	**94.8**	96.4	88.0
Lean over	**94.8**	96.4	88.0
Duck	**94.8**	96.4	88.0
Dive behind cover	**94.6**	96.4	85.0
Jump	**93.6**	95.2	85.0
Squat/duck walk	**93.6**	94.8	88.0
Rotate body	**93.6**	94.8	88.0
Hit & roll	**93.3**	94.5	88.0
Lie down on back	**91.4**	92.2	88.0
***Potential* Overall TTES usefulness: Body Movements**	**94.3**	**96.5**	**85.0**

- The 1994 survey resulted in a 83.5% *Importance* rating for this category, while 94.3% was calculated for *Potential Usefulness* in 1995 (about a 12% difference). The experts surveyed this year apparently consider their real-world Adversaries to be about as capable as themselves, and want them modeled that way.

Current Capability of TTES to Emulate Listed Factors

- Eight of the 17 Individual Body Movements were rated by the Total Group above 50% in *Current Capability* for Adversaries; reasonable progress is perceived for the last year in modeling these movements.

- Ratings for the remaining nine Body Movements ranged from 47.5 down to 32.9%. These areas are seen as needing additional enhancements in capability, with little or no progress made in the past year (in fact, Kneel down was rated somewhat worse this year).

- Overall, Adversaries' *Current Capability* to carry out complex Body Movements was rated by the Total Group at only 58.9% in 1995. However, this compares with 44.6% in 1994 — indicating about a 30% improvement. Progress is being made!

	Current Capability Rating for Adversary			
Individual Body Movements	Total Group	Military	Civilian	1994 Total Group
Stand up	**70.0**	72.2	60.0	**62.5**
Walk forwards	**66.4**	68.9	55.0	**53.8**
Run	**63.2**	64.0	60.0	**47.5**
Walk backwards	**61.9**	65.9	45.0	**56.3**
Squat/duck walk	**60.0**	64.0	45.0	**41.3**
Lie down on front	**57.0**	60.0	45.0	**55.0**
Rotate body	**56.8**	60.0	45.0	**43.8**
Kneel down	**55.8**	58.7	45.0	**58.8**
Duck	**47.5**	48.3	45.0	**52.5**
Crawl	**46.7**	47.1	45.0	**33.3**
Lean over	**45.0**	45.0	45.0	**43.8**
Lie down on back	**40.0**	38.3	45.0	**40.0**
Roll right & left	**40.0**	38.2	45.0	**37.3**
Hit & roll	**36.0**	32.7	45.0	**33.3**
Climb/crawl over obstacles	**35.4**	32.0	46.7	**32.9**
Jump	**33.8**	30.0	46.7	**33.3**
Dive behind cover	**32.9**	29.1	46.7	**33.3**
***Current* Overall TTES capability: Body Movements**	**58.9**	**64.0**	**33.3**	**44.6**

4.3.3 Firing Positions

3.a. **Trainee firing positions**. What tactically correct firing positions and other body positions should TTES allow trainees to use in the simulator?

Potential Usefulness of Listed Factors for TTES Training

	Potential Usefulness Rating for Trainee		
Firing Positions	**Total Group**	**Military**	**Civilian**
Kneeling	**98.6**	98.3	100.0
Standing	**98.6**	98.3	100.0
From holes	**97.5**	97.0	100.0
Through doors	**97.0**	96.4	100.0
Through windows	**96.3**	95.5	100.0
Squatting or crouched	**96.0**	95.0	100.0
From behind trees	**95.7**	94.7	100.0
From under vehicles	**95.0**	94.0	100.0
Prone	**95.0**	93.9	100.0
Barricaded	**94.8**	93.7	100.0
Supported	**94.4**	93.3	100.0
Sitting	**92.8**	91.4	100.0
On back	**79.2**	75.0	100.0
***Potential* Overall TTES usefulness: Firing Positions**	**96.0**	**95.0**	**100.0**

- With the exception of On back (which rated fairly low), the TTES evaluators consider all of the listed Firing Positions to have very high *Potential Usefulness* (better than 90%), placing them in the *critical* classification for Trainees.

- Calculated ratings for the Civilian group were 100% for all of the listed Body Movements.

- An average Total Group *Importance* rating of 88.2% was calculated for this category in 1994. This is less than 10% lower than the 96.0% *Potential Usefulness* rating given in 1995, indicating that the 1994 and 1995 groups held similar opinions about the importance/ usefulness of these Firing Positions for Trainees.

Current Capability of TTES to Emulate Listed Factors

- The seven Firing Positions that were rated better than 50% in *Current Capability* for Trainees generally reflect the capabilities currently implemented in TTES. The ratings range from 80.7 to 51.3%, indicating that standing is considered to be quite well implemented, while sitting would be harder to do in the current version of TTES.

	Current Capability Rating for Trainee			
Firing Positions	**Total Group**	**Military**	**Civilian**	**1994 Total Group**
Standing	**80.7**	80.0	84.0	**64.7**
Kneeling	**73.6**	71.4	85.0	**54.1**
Through windows	**72.0**	71.3	75.0	**57.6**
Through doors	**72.0**	70.7	76.0	**58.8**
Squatting or crouched	**67.0**	61.3	84.0	**55.3**
Prone	**64.2**	60.0	80.0	**51.8**
Sitting	**51.3**	44.6	80.0	**51.8**
Supported	**48.0**	41.7	73.3	**36.3**
From holes	**47.1**	41.8	66.7	**44.7**
Barricaded	**45.3**	36.7	80.0	**33.8**
From behind trees	**40.0**	35.0	60.0	**33.8**
From under vehicles	**40.0**	34.0	60.0	**46.3**
On back	**37.1**	27.3	73.3	**40.0**
***Current* Overall TTES capability: Firing Positions**	**57.3**	**56.7**	**60.0**	**46.2**

- The remaining six Firing Positions are not possible in TTES systems at present, so low satisfaction with *Current Capability* is not surprising.

- All but three of the listed Firing Positions are perceived as being improved since last year, though the differences mostly are not important.

- The 1995 Overall *Current Capability* rating for Trainee Firing Positions, 57.3%, compares with a value of 46.2% for 1994, suggesting that significant improvements may have been made in the past year.

3.b. **Simulated adversary positions**. What firing positions and other body positions should TTES be able to simulate for hostiles, neutrals, and friendlies, as trainees decide whether to fire?

Potential Usefulness of Listed Factors for TTES Training

- Total Group ratings for the *Potential Usefulness* of various Adversary Firing Positions are only slightly lower than *Potential Usefulness* ratings for the same factors for the Trainee.

	Potential Usefulness Rating for Adversary		
Firing Positions	**Total Group**	**Military**	**Civilian**
Kneeling	**99.3**	99.1	100.0
Standing	**99.3**	99.1	100.0
Prone	**98.5**	98.3	100.0
Squatting or crouched	**95.4**	94.5	100.0
Through windows	**95.4**	94.5	100.0
Through doors	**95.4**	94.5	100.0
Supported	**94.4**	93.6	100.0
Sitting	**93.6**	92.7	100.0
From holes	**93.6**	92.7	100.0
From behind trees	**93.6**	92.7	100.0
Barricaded	**91.7**	90.5	100.0
From under vehicles	**91.2**	90.0	100.0
On back	**77.6**	74.5	100.0
***Potential* Overall TTES usefulness: Firing Positions**	**93.6**	**92.6**	**100.0**

- The over-90% ratings for 12 of the 13 Firing Positions places all of these simulation factors except On back (rated substantially lower) in the *critical* classification.

- Civilians were unanimous in giving all factors a top rating, resulting in values of 100% for all Firing Positions.

- In 1994, this category received a Total Group *Importance* rating of 83.8%. This compares with a 1995 93.6% *Potential Usefulness* rating, about a 12% difference. The 1995 experts obviously want to practice their skills against adversaries as capable as will be found in real-world combat.

Current Capability of TTES to Emulate Listed Factors

- The Total Group rated six of the listed Firing Positions above 50% in *Current Capability*. 1994 and 1995 ratings indicate that all but one of these six (Squatting or crouched) have been extensively improved in the past year (up to nearly 20% better).

- Little or no improvement was observed for the remaining seven positions (most of which have not been modeled in TTES at all).

Firing Positions	Current Capability Rating for Adversary			
	Total Group	Military	Civilian	1994 Total Group
Standing	**75.7**	76.0	73.3	**64.7**
Through windows	**69.0**	70.6	60.0	**57.6**
Through doors	**66.7**	68.0	60.0	**58.8**
Kneeling	**64.2**	62.5	73.3	**54.1**
Prone	**62.0**	60.0	73.3	**51.8**
Squatting or crouched	**54.7**	50.0	73.3	**55.3**
Supported	**45.7**	43.3	60.0	**36.3**
Sitting	**40.0**	36.4	60.0	**51.8**
From holes	**40.0**	36.4	60.0	**44.7**
Barricaded	**40.0**	36.0	60.0	**33.8**
From behind trees	**36.7**	30.0	70.0	**33.8**
From under vehicles	**33.3**	34.0	30.0	**46.3**
On back	**33.3**	28.0	60.0	**40.0**
***Current* Overall TTES capability: Firing Positions**	**56.5**	**57.3**	**50.0**	**46.2**

- The Overall *Current Capability* rating of 56.5% for Adversary Firing Positions compares with 46.2% in 1994 — about a 22% change.

4.3.4 Arm and Hand Movements

4.a. **Trainee arm and hand movements**. What tactically correct arm and hand movements should TTES allow trainees to perform in the simulator, as they move through training situations?

Potential Usefulness of Listed Factors for TTES Training

Arm & Hand Movements	Potential Usefulness Rating for Trainee		
	Total Group	Military	Civilian
Left & right	**97.6**	98.1	95.0
Diagonal (up & to the right, etc.)	**97.6**	98.1	95.0
Bend elbows & wrists	**97.6**	98.1	95.0
Up & down	**96.9**	97.3	95.0
Open doors	**96.9**	97.1	96.0
Open windows	**96.9**	97.1	96.0
Manipulate weapons	**96.8**	97.1	95.0
Draw weapons	**96.7**	97.0	95.0
Transition between weapons	**96.7**	97.0	95.0
Shoot weapons	**96.3**	96.4	96.0
Change hands	**96.0**	96.2	95.0
Reach for objects	**95.8**	98.0	85.0
Grab or grasp objects	**95.8**	98.0	85.0
Push objects away	**95.4**	97.1	88.0
Pick up objects	**95.0**	97.0	85.0
Throw objects (e.g., grenades)	**94.4**	95.2	90.0
Use rifle as pugil	**90.4**	91.4	85.0
***Potential* Overall TTES usefulness: Arm & Hand Movements**	**95.5**	**96.5**	**92.0**

- The 1995 Total Group rated all Arm & Hand Movement factors above 90% in *Potential Usefulness* for the Trainee. All must be considered *critical* capabilities to include in TTES.

- In 1994 this category received a Total Group overall average *Importance* rating of 86.4% for the Trainee. The 1995 *Potential Usefulness* rating of 95.5% suggests about a 10% increase in perceived importance or usefulness as TTES realism has grown.

Current Capability of TTES to Emulate Listed Factors

- Only the ability to Shoot Weapons is rated above 50% in *Current Capability*, as the Trainee attempts to use a variety of Arm & Hand Movements. Respondents obviously feel very constrained by the present system that tethers them to sensing devices rather than allowing free movement as in the real world — and in the envisioned TTES system.

	Current Capability Rating for Trainee			
Arm & Hand Movements	**Total Group**	**Military**	**Civilian**	**1994 Total Group**
Shoot weapons	**66.4**	69.5	46.7	**47.8**
Manipulate weapons	**45.0**	47.1	30.0	**40.0**
Left & right	**41.4**	40.0	50.0	**37.6**
Up & down	**41.3**	40.0	50.0	**37.6**
Diagonal (up & to the right, etc.)	**33.8**	34.5	30.0	**35.3**
Bend elbows & wrists	**32.3**	32.7	30.0	**32.9**
Draw weapons	**31.4**	31.7	30.0	**35.3**
Change hands	**30.8**	30.9	30.0	**32.9**
Use rifle as pugil	**29.2**	29.1	30.0	**33.8**
Throw objects (e.g., grenades)	**28.3**	28.0	30.0	**27.1**
Open doors	**27.7**	27.3	30.0	**29.4**
Open windows	**27.7**	27.3	30.0	**32.9**
Transition between weapons	**27.7**	27.3	30.0	**34.1**
Push objects away	**26.7**	26.0	30.0	**28.2**
Reach for objects	**26.2**	25.5	30.0	**30.6**
Grab or grasp objects	**26.2**	25.5	30.0	**28.2**
Pick up objects	**26.2**	25.5	30.0	**29.4**
***Current* Overall TTES capability: Arm & Hand Movements**	**49.0**	**51.3**	**40.0**	**33.3**

- Except for the ability to Shoot Weapons, little improvement can be inferred for any of the Arm & Hand Movement factors since the 1994 survey — although the Overall category rating does indicate some progress.

4.b. **Simulated adversary arm and hand movements.** What tactically correct arm and hand movements should TTES be able to simulate for hostiles, neutrals, and friendlies, as trainees go through training situations?

Potential Usefulness of Listed Factors for TTES Training

- The Total Group rated all Arm & Hand Movements better than 90% in *Potential Usefulness* for simulated Adversaries, indicating that all are *critical* to include.

	Potential Usefulness Rating for Adversary		
Arm & Hand Movements	**Total Group**	**Military**	**Civilian**
Shoot weapons	**95.6**	97.3	88.0
Manipulate weapons	**95.4**	97.3	85.0
Up & down	**94.6**	96.4	85.0
Left & right	**94.6**	96.4	85.0
Bend elbows & wrists	**94.6**	96.4	85.0
Open doors	**94.6**	96.4	85.0
Draw weapons	**94.6**	96.4	85.0
Reach for objects	**94.4**	96.2	85.0
Grab or grasp objects	**94.4**	96.2	85.0
Pick up objects	**94.4**	96.2	85.0
Throw objects (e.g., grenades)	**93.8**	95.5	85.0
Change hands	**93.1**	94.5	85.0
Open windows	**93.1**	94.5	85.0
Use rifle as pugil	**93.1**	94.5	85.0
Transition between weapons	**92.8**	94.3	85.0
Diagonal (up & to the right, etc.)	**92.3**	93.6	85.0
Push objects away	**92.3**	93.6	85.0
***Potential* Overall TTES usefulness: Arm & Hand Movements**	**93.9**	**95.6**	**88.0**

- Military respondents generally gave higher ratings to these items than did the Civilians.

- In 1994, the Total Group of respondents gave an average *Importance* rating of 82.4% to this overall category for Adversaries, about 14% lower than 1995's 93.9% Overall *Potential Usefulness* rating.

Current Capability of TTES to Emulate Listed Factors

- Simulated Adversary *Current Capability* to utilize a variety of Arm & Hand Movements is considered poor (with the possible exception of Shoot Weapons) — but maybe a bit better than the Trainee's movements. The Total Group's Overall rating for this category is 50.6% for Adversary Arm & Hand Movements, compared with 49.0% for the Trainee.

- The group of Military respondents generally rated *Current Capability* of the Adversary factors even lower than did the Civilian group.

- In spite of continued low scores, an Overall improvement of more than 50% can be inferred from the two Adversary *Current Capability* Total Group ratings, 33.3% in 1994 and 50.6% in 1995.

Arm & Hand Movements	Current Capability Rating for Adversary			
	Total Group	Military	Civilian	1994 Total Group
Shoot weapons	**60.0**	58.8	70.0	**47.8**
Manipulate weapons	**44.3**	44.6	40.0	**40.0**
Up & down	**37.1**	36.9	40.0	**37.6**
Left & right	**36.9**	36.7	40.0	**37.6**
Draw weapons	**33.3**	32.7	40.0	**35.3**
Diagonal (up & to the right, etc.)	**31.7**	30.9	40.0	**35.3**
Bend elbows & wrists	**30.0**	29.1	40.0	**32.9**
Reach for objects	**30.0**	29.1	40.0	**30.6**
Grab or grasp objects	**30.0**	29.1	40.0	**28.2**
Use rifle as pugil	**30.0**	29.1	40.0	**33.8**
Throw objects (e.g., grenades)	**29.1**	28.0	40.0	**27.1**
Open doors	**28.3**	27.3	40.0	**29.4**
Open windows	**28.3**	27.3	40.0	**32.9**
Transition between weapons	**28.3**	27.3	40.0	**34.1**
Pick up objects	**27.3**	26.0	40.0	**29.4**
Change hands	**27.3**	26.0	40.0	**32.9**
Push objects away	**27.3**	26.0	40.0	**28.2**
***Current* Overall TTES capability: Arm & Hand Movements**	**50.6**	**50.0**	**53.3**	**33.3**

4.3.5 Head Movements

5.a. **Trainee head movements**. What tactically correct trainee head movements are trainees likely to perform and for which TTES should provide a simulated field of regard?

Potential Usefulness of Listed Factors for TTES Training

Head Movements	Potential Usefulness Rating for Trainee		
	Total Group	Military	Civilian
Fast tracking of moving object	**98.5**	98.2	100.0
Look over shoulder/behind	**98.5**	98.2	100.0
Peek/look over obstacle	**98.5**	98.2	100.0
Slow scan of area	**97.9**	97.4	100.0
Peek/look around corner	**97.9**	97.4	100.0
Up & down	**97.8**	97.3	100.0
Aim through sight	**97.8**	97.3	100.0
Duck	**97.7**	97.1	100.0
Left & right	**97.1**	96.5	100.0
Bend & look	**97.0**	96.4	100.0
Diagonal (up & to the right, etc.)	**96.3**	95.5	100.0
Put face in dirt	**88.8**	90.5	80.0
***Potential* Overall TTES usefulness: Head Movements**	**97.5**	**96.8**	**100.0**

- Except for one item, the listed Head Movements were among the highest rated simulation factors in *Potential Usefulness* for Trainees, and definitely should be considered *critical* for TTES. Trainees do not want their heads constrained.

- Put face in dirt is considered by the Total Group the least *Potentially Useful* Head Movement for Trainees in 1995 (88.8%); this factor also came in last in this category on the 1994 survey.

- An *Importance* rating of 89.8% was calculated for this category of simulation factors in 1994, the highest of any for Trainees. The 1995 *Potential Usefulness* value of 97.5% also is the highest rating for Trainee factors (and second only to Sounds in the entire survey). The ratings indicate a perceived increase of about 8% in Head Movement importance or usefulness over the already high 1994 rating.

Current Capability of TTES to Emulate Listed Factors

- *Current Capability* to utilize a variety of Head Movements is perceived as pretty good by the Total Group, with all but three of the listed factors rated above 50%.

	Current Capability Rating for Trainee			
Head Movements	**Total Group**	**Military**	**Civilian**	**1994 Total Group**
Slow scan of area	**60.8**	63.0	50.0	**66.7**
Aim through sight	**59.2**	61.0	50.0	**53.8**
Left & right	**57.6**	60.0	45.0	**50.0**
Up & down	**55.5**	55.6	55.0	**43.8**
Fast tracking of moving object	**54.5**	56.7	45.0	**37.5**
Bend & look	**52.7**	54.4	45.0	**50.0**
Duck	**51.6**	54.7	40.0	**55.0**
Peek/look over obstacle	**50.4**	52.6	40.0	**47.5**
Peek/look around corner	**50.0**	51.0	45.0	**50.0**
Diagonal (up & to the right, etc.)	**47.4**	48.0	45.0	**47.5**
Look over shoulder/behind	**37.1**	37.6	35.0	**33.3**
Put face in dirt	**27.1**	29.1	20.0	**41.3**
***Current* Overall TTES capability: Head Movements**	**52.7**	**55.6**	**40.0**	**50.0**

- The group of five Civilians was less impressed with TTES *Current Capability* than were the Military respondents, for this simulation category.

- Very little progress is perceived from 1994, with the Total Group's Overall *Current Capability* rating rising only from 50.0 to 52.7%.

5.b. **Simulated adversary head movements.** What tactically correct head movements should TTES be able to simulate for hostiles, neutrals, and friendlies?

Potential Usefulness of Listed Factors for TTES Training

- For their TTES Adversaries, the Total Group of respondents feels that all of the listed factors (including Put face in dirt) have very high *Potential Usefulness*; all fall in the *critical*-to-include category.

	Potential Usefulness Rating for Adversary		
Head Movements	Total Group	Military	Civilian
Aim through sight	**96.8**	96.4	100.0
Look over shoulder/behind	**96.0**	95.5	100.0
Peek/look around corner	**96.0**	95.5	100.0
Peek/look over obstacle	**96.0**	95.5	100.0
Duck	**95.8**	95.2	100.0
Up & down	**95.2**	94.5	100.0
Left & right	**95.2**	94.5	100.0
Fast tracking of moving object	**94.4**	93.6	100.0
Bend & look	**94.4**	93.6	100.0
Diagonal (up & to the right, etc.)	**93.6**	92.7	100.0
Slow scan of area	**92.8**	93.6	86.7
Put face in dirt	**90.0**	90.5	86.7
***Potential* Overall TTES usefulness: Head Movements**	**93.6**	**93.3**	**95.0**

- The *Potential Usefulness* of the listed Head Movements is perceived as slightly more important for Trainees (97.5%) than for Adversaries (93.6%).

- When the 1994 Overall Total Group *Importance* rating (81.8%) is compared with the 1995 *Potential Usefulness* rating (93.6%), about a 14% increase is observed from last year.

Current Capability of TTES to Emulate Listed Factors

	Current Capability Rating for Adversary			
Head Movements	Total Group	Military	Civilian	1994 Total Group
Left & right	**45.3**	49.2	20.0	**50.0**
Slow scan of area	**45.3**	49.2	20.0	**66.7**
Fast tracking of moving object	**42.9**	46.7	20.0	**37.5**
Duck	**41.4**	45.0	20.0	**55.0**
Peek/look around corner	**41.3**	44.6	20.0	**50.0**
Aim through sight	**41.3**	44.6	20.0	**53.8**
Peek/look over obstacle	**40.0**	43.3	20.0	**47.5**
Up & down	**36.9**	40.0	20.0	**43.8**
Diagonal (up & to the right, etc.)	**36.9**	40.0	20.0	**47.5**
Bend & look	**36.9**	40.0	20.0	**50.0**
Look over shoulder/behind	**32.3**	34.5	20.0	**33.3**
Put face in dirt	**31.7**	34.0	20.0	**41.3**
***Current* Overall TTES capability: Head Movements**	**48.0**	**55.0**	**20.0**	**50.0**

- Modeling of Adversary Head Movements is seen as very poor at present, with all listed factors rated below 50% in *Current Capability*.

- The Civilian respondents especially down-rated this category.

- Respondents judged that the Trainee's *Current Capability* to use a variety of Head Movements in TTES scenarios is somewhat better than the modeled Adversary's ability: 52.7% compared with 48.0%.

- Although the difference is not statistically significant, the Total Group's *Current Capability* rating for Adversary Head Movements has dropped 2 points since 1994. This may indicate that other simulated capabilities have improved enough so that the simulated Head Movements now are perceived as less well modeled.

4.3.6 Eye Movements

6.a. **Trainee eye movements**. What tactically correct eye movements are trainees likely to perform and for which TTES should provide a simulated field of regard?

Potential Usefulness of Listed Factors for TTES Training

- The *Potential Usefulness* of Trainee Eye Movements is rated surprisingly high (96.4%) by the Total Group, almost as high as Head Movements (97.5%). All listed movements fall into the *critical* classification. Glancing around obviously is considered a natural (and important) thing to do during training exercises.

	Potential Usefulness Rating for Trainee		
Eye Movements	**Total Group**	**Military**	**Civilian**
Fast tracking of moving objects	**98.4**	98.0	100.0
Sight alignment	**98.4**	98.0	100.0
Scan area, limited head motion	**97.7**	97.1	100.0
Through peep holes	**96.8**	96.0	100.0
Diagonal (up & to the right, etc.)	**95.4**	96.2	92.0
Up & down	**94.6**	93.3	100.0
Left & right	**94.1**	92.7	100.0
***Potential* Overall TTES usefulness: Eye Movements**	**96.4**	**95.3**	**100.0**

- In 1994, the Total Group's average Eye Movement *Importance* rating was 84.9% for the Trainee. This compares with the 1995 *Potential Usefulness* value of 96.4%, about a 13% perceived increase in importance or usefulness.

Current Capability of TTES to Emulate Listed Factors

- The Trainee's *Current Capability* to move eyes Up & down and Left & right is judged fairly good by the Total Group, with Sight alignment and Diagonal movements also rated above 50%.

Eye Movements	Current Capability Rating for Trainee			
	Total Group	Military	Civilian	1994 Total Group
Up & down	**61.9**	65.9	45.0	**42.5**
Left & right	**61.0**	65.6	33.3	**41.3**
Sight alignment	**54.0**	58.8	26.7	**40.0**
Diagonal (up & to the right, etc.)	**52.9**	57.1	33.3	**42.5**
Fast tracking of moving objects	**46.3**	48.8	33.3	**32.5**
Scan area, limited head motion	**46.0**	48.2	33.3	**40.0**
Through peep holes	**42.5**	46.2	26.7	**32.5**
***Current* Overall TTES capability: Eye Movements**	**51.6**	**56.0**	**35.0**	**40.0**

- Fast tracking and Scan area probably are downrated because the current TTES head-position tracker has difficulty keeping up with rapid movements. Objects on the TTES screen cannot be approached close enough to look Through peep holes at present.

- The Civilian group generally rated the listed *Current Capability* for Eye Movements much lower than did the Military Group. Possibly subtle eye movements are more important in law enforcement activities than in out-and-out combat.

- The 1995 Total Group perception of TTES Overall *Current Capability* for Trainee Eye Movements (51.6%) is nearly 30% higher than was the perception by the 1994 Total Group (40.0%).

6.b. **Simulated adversary eye movements.** What tactically correct eye movements should TTES be able to simulate for hostiles, neutrals, and friendlies?

Potential Usefulness of Listed Factors for TTES Training

- The *Potential Usefulness* of the Adversary being able to Scan area is rated at 90.0% by the Total group, just into the *critical* classification.

Eye Movements	Potential Usefulness Rating for Adversary		
	Total Group	Military	Civilian
Scan area, limited head motion	**90.0**	92.0	70.0
Fast tracking of moving objects	**88.6**	90.5	70.0
Through peep holes	**88.2**	90.0	70.0
Sight alignment	**88.2**	90.0	70.0
Diagonal (up & to the right, etc.)	**87.8**	89.5	70.0
Up & down	**86.1**	87.6	70.0
Left & right	**86.1**	87.6	70.0
***Potential* Overall TTES usefulness: Eye Movements**	**86.7**	**88.8**	**70.0**

- The remaining six listed Adversary Eye Movements, rated between 86% and 89%, should be classed as *extremely important* to include.

- The *Potential Usefulness* of Trainee Eye Movements (96.4%) is rated substantially higher than Adversary Eye Movements (86.7%).

- The 1995 Total Group *Potential Usefulness* rating of 86.7% for the Adversary Eye Movement category compares with a calculated average *Importance* rating of 74.6% in 1994, indicating about a 16% increase in perceived usefulness or importance.

- Implementing the great range of Adversary Eye Movements listed here (and considered useful by the subject matter experts) will be extremely difficult to do, using the current TTES human entity model.

Current Capability of TTES to Emulate Listed Factors

- Adversary Left & right Eye Movements are the only listed items rated above 50% in *Current Capability* by the Total Group in 1995.

	Current Capability Rating for Adversary			
Eye Movements	**Total Group**	**Military**	**Civilian**	**1994 Total Group**
Left & right	**50.9**	50.9	—	**41.3**
Sight alignment	**49.1**	49.1	—	**40.0**
Up & down	**48.0**	48.0	—	**42.5**
Scan area, limited head motion	**43.3**	43.3	—	**40.0**
Fast tracking of moving objects	**42.0**	42.0	—	**32.5**
Diagonal (up & to the right, etc.)	**41.8**	41.8	—	**42.5**
Through peep holes	**38.0**	38.0	—	**32.5**
***Current* Overall TTES capability: Eye Movements**	**54.5**	**54.0**	**60.0**	**40.0**

- None of the five Civilians provided ratings for the individual factors in this particular category.

- As noted above, implementation of a variety of Adversary Eye Movements is not possible in the current version of TTES, and will be very difficult (expensive) to do in the future. The relatively high ratings for items in this category (even though mostly less than 50%) may indicate that the survey respondents recognize the difficulty of implementing the listed Adversary Eye Movements and so do not expect very great capability.

- About a 35% increase in *Current Capability* over the past year can be inferred from the 1994 and 1995 Total Group ratings. This is surprising, since the current TTES adversary entities have no ability to move their eyes apart from moving the entire head..

5.0 SUMMARY RESULTS

The results for individual questions provided above now can be summarized and reviewed as a whole. The following section includes this summarization, discusses the results, and provides several conclusions that should be considered during further TTES development.

5.1 POTENTIAL USEFULNESS RATINGS

A total of 28 subject matter experts were asked to evaluate the *Potential Usefulness* of numerous individual simulation factors, grouped into 17 categories. They also gave an overall rating for the usefulness of each category as a whole. The overall ratings for the 17 categories are summarized in the following table separately for the Total group and for Military and Civilian respondents (it should be recalled that only five civilians participated in the 1995 survey). Average *Importance* ratings from the 1994 survey are included in the last column, for comparison. The Mission Preview and Mission Rehearsal categories were not included in the 1994 survey.

Simulation Capability Categories	Potential Usefulness or Importance			
	1995 Total Group	1995 Military	1995 Civilians	1994 Total Group
A.1 Training Situations	**96.4**	95.6	100.0	**76.4**
A.2. Marksmanship Events	**95.0**	95.0	95.0	**85.0**
A.3. Discretionary Decisions	**95.2**	95.3	95.0	**83.5**
A.4. Mission Preview	**94.8**	95.0	93.3	–
A.5. Mission Rehearsal	**93.9**	94.7	90.0	–
B.1. Environments	**92.0**	90.6	100.0	**81.9**
B.2. Environmental Effects	**92.6**	90.7	100.0	**83.7**
B.3. General Objects	**96.8**	97.3	95.0	**84.9**
B.4. Simulated Humans	**96.4**	95.6	100.0	**92.7**
B.5. Weapons	**91.0**	90.6	93.3	**81.8**
B.6. Sounds	**98.0**	98.8	95.0	**86.7**
C.1. Tactical Movements: Trainee	**96.2**	95.3	100.0	**85.2**
C.2. Individual Body Movements: Trainee	**95.2**	96.5	90.0	**88.0**
C.3. Firing Positions: Trainee	**96.0**	95.0	100.0	**88.2**
C.4. Arm & Hand Movements: Trainee	**95.5**	96.5	92.0	**86.4**
C.5. Head Movements: Trainee	**97.5**	96.8	100.0	**89.8**
C.6. Eye Movements: Trainee	**96.4**	95.3	100.0	**84.9**
C.1. Tactical Movements: Adversary	**94.7**	97.3	85.0	**74.6**
C.2. Individual Body Movements: Adversary	**94.3**	96.5	85.0	**83.5**
C.3. Firing Positions: Adversary	**93.6**	92.6	100.0	**83.8**
C.4. Arm & Hand Movements: Adversary	**93.9**	95.6	88.0	**82.4**
C.5. Head Movements: Adversary	**93.6**	93.3	95.0	**81.8**
C.6. Eye Movements: Adversary	**86.7**	88.8	70.0	**74.6**
Averages	**94.6**	**94.7**	**94.0**	**83.8**

5.1.1 TTES Capabilities for Trainees and for Simulated Adversaries

It should be noted that Sections A and B of the questionnaire asked individual questions related to simulator design (that is, the kinds of situations, environments, and objects that should be emulated in TTES) while the questions in Section C were different. *Two* questions were asked for

each category in Section C: (1) what capabilities should TTES provide for *Trainees,* and (2) what capabilities should TTES simulate for the *Adversaries* with which the trainees will interact.

- Overall, the respondents reported that the factors in the six categories of questionnaire Section C are somewhat more useful for Trainees than for simulated Adversaries (an average *Potential Usefulness* value of 96.1%, compared with 92.6%). However, the difference is not as pronounced as in 1994 when Trainee *Importance* ratings averaged 87.1% while the average Adversary rating was 80.1%

- All of 1995 respondents are experienced trainers. This provides an interesting comparison with the 1994 results. At that time, the Total Group provided an average *Importance* rating of 87.1% for all of the Trainee factors while the subgroup of 13 trainers gave an average rating of 97.8% for these factors — quite close to the 1995 rating of 96.1%.

- From the subject matter expert judgments it is obvious that the final TTES system should not constrain the activities of its users any more than is absolutely necessary. Equipment used by trainees should allow them to carry out, in a normal manner, those procedures and activities that are common during combat — insofar as is reasonable to emulate.

- Results of the 1994 survey indicated a general attitude that the adversary is inherently inferior (or at least less capable) and requires a less sophisticated representation in TTES. It is reassuring that no such attitude is observed in the 1995 survey results. Such a perception would be extremely dangerous in real-world combat; nothing encountered during training should reinforce this misconception in any way. The adversaries engaged during TTES training must appear to be bright, clever, and fully capable of carrying out well-planned and skilled coordinated tactics.

5.1.2 Military Versus Civilian Ratings

The group of five civilians who participated in the study is so small that little validity can be given to their average results, when taken alone. For some individual simulation categories the Civilian group responses are considerably greater or smaller than those for the Military respondents and for the Total Group (which tracked closely due to the preponderance of Military participants). Yet, as may be observed on the bottom line of the above table, the overall average results for the Civilian group do not differ in any significant way from those of the Total Group.

- Although the Civilian responses cannot be considered valid representations of the population of civilian law enforcement officers (and their average results should not be used alone), the group's survey responses are generally similar to those of the Military respondents and to the Total Group. Inclusion in the overall survey results will result in a larger sample and should not bias the overall results substantially.

5.1.3 Overall Category Usefulness

The relative overall *Potential Usefulness* of the categories easily can be examined using the information from the above table if it is sorted so that the highest-rated categories are at the top. This has been done in the table below.

Simulation Capability Categories	Potential Usefulness or Importance			
	1995 Total Group	1995 Military	1995 Civilians	1994 Total Group
B.6. Sounds	**98.0**	98.8	95.0	**86.7**
C.5. Head Movements: Trainee	**97.5**	96.8	100.0	**89.8**
B.3. General Objects	**96.8**	97.3	95.0	**84.9**
B.4. Simulated Humans	**96.4**	95.6	100.0	**92.7**
C.6. Eye Movements: Trainee	**96.4**	95.3	100.0	**84.9**
C.1. Tactical Movements: Trainee	**96.2**	95.3	100.0	**85.2**
C.3. Firing Positions: Trainee	**96.0**	95.0	100.0	**88.2**
C.4. Arm & Hand Movements: Trainee	**95.5**	96.5	92.0	**86.4**
A.1 Training Situations	**95.4**	95.6	100.0	**76.4**
C.2. Individual Body Movements: Trainee	**95.2**	96.5	90.0	**88.0**
A.3. Discretionary Decisions	**95.2**	95.3	95.0	**83.5**
A.2. Marksmanship Events	**95.0**	95.0	95.0	**85.0**
A.4. Mission Preview	**94.8**	95.0	93.3	--
C.1. Tactical Movements: Adversary	**94.7**	97.3	85.0	**74.6**
C.2. Individual Body Movements: Adversary	**94.3**	96.5	85.0	**83.5**
C.4. Arm & Hand Movements: Adversary	**93.9**	95.6	88.0	**82.4**
A.5. Mission Rehearsal	**93.9**	94.7	90.0	--
C.3. Firing Positions: Adversary	**93.6**	92.6	100.0	**83.8**
C.5. Head Movements: Adversary	**93.6**	93.3	95.0	**81.8**
B.2. Environmental Effects	**92.6**	90.7	100.0	**83.7**
B.1. Environments	**92.0**	90.6	100.0	**81.9**
B.5. Weapons	**91.0**	90.6	93.3	**81.8**
C.6. Eye Movements: Adversary	**86.7**	88.8	70.0	**74.6**
Averages	**94.6**	**94.7**	**94.0**	**83.8**

- While the trend for the top-rated categories (scoring over 90%) in *Potential Usefulness* is interesting (moving from Sounds at 98.0% down to Weapons at 91.0%), the differences are too small to be significant. The closeness of the assigned ratings indicates that the survey respondents consider inclusion of all of these categories critical.

- Eye Movements for the Adversary is rated substantially below the other categories. It appears that high-fidelity simulation of the facial features of hostiles, neutrals, and friendlies is considered less important than is modeling of numerous battlefield situations, events, and objects.

- The ratings indicate that in 1995 TTES was perceived about equally useful as a trainer for Discretionary Decisions (95.2%) and Marksmanship (95.0%). This is a major change from 1994, when TTES was considered primarily a Marksmanship trainer (85%) and to a lesser degree a Discretionary Decisions trainer (83.5%). The changed perception no doubt is due to advances in TTES implementation, and was predicted last year. In 1994, all simulated humans were adversaries and simply were targets to be fired at. The 1995 version of TTES is more sophisticated, includes neutrals and friendlies (fire team members) as well as hostiles, and requires trainees to think before they shoot.

5.2 CURRENT CAPABILITY RATINGS

The following table summarizes the survey participants' responses regarding how capable they consider TTES *currently* is, both to meet Trainee needs for various scenarios and to simulate objects and combat environments. Overall ratings for the 1995 Total Group and the two individual subgroups are provided for the 17 categories, along with Total Group responses from 1994. Two simulation categories, Mission Preview and Mission Rehearsal, were not included on the 1994 questionnaires.

In 1994 the survey respondents were not asked to provide separate judgments on TTES capabilities for simulating Adversaries and for meeting Trainee needs; a single judgment served to evaluate both. This was considered a weakness of the 1994 survey and was corrected on the 1995 questionnaire. For this table, the 1994 Total Group *Current Capability* ratings simply are repeated for Trainees and Adversaries.

	Current Capability			
Simulation Capability Categories	**1995 Total Group**	**1995 Military**	**1995 Civilians**	**1994 Total Group**
A.1 Training Situations	**69.5**	71.8	60.0	**45.0**
A.2. Marksmanship Events	**71.1**	71.4	70.0	**46.3**
A.3. Discretionary Decisions	**70.0**	70.0	70.0	**41.3**
A.4. Mission Preview	**72.6**	75.0	60.0	–
A.5. Mission Rehearsal	**73.0**	72.9	73.3	–
B.1. Environments	**74.1**	74.7	70.0	**54.3**
B.2. Environmental Effects	**54.1**	58.5	40.0	**36.0**
B.3. General Objects	**64.4**	66.7	53.3	**42.9**
B.4. Simulated Humans	**69.5**	67.8	80.0	**42.9**
B.5. Weapons	**63.2**	67.1	30.0	**33.3**
B.6. Sounds	**60.0**	65.3	33.3	**30.7**
C.1. Tactical Movements: Trainee	**58.0**	60.0	50.0	**40.0**
C.2. Individual Body Movements: Trainee	**60.0**	61.3	53.3	**44.6**
C.3. Firing Positions: Trainee	**57.3**	56.7	60.0	**46.2**
C.4. Arm & Hand Movements: Trainee	**49.0**	51.3	40.0	**33.3**
C.5. Head Movements: Trainee	**52.7**	55.6	40.0	**50.0**
C.6. Eye Movements: Trainee	**51.6**	56.0	35.0	**40.0**
C.1. Tactical Movements: Adversary	**47.1**	49.1	40.0	**40.0**
C.2. Individual Body Movements: Adversary	**58.9**	64.0	33.3	**44.6**
C.3. Firing Positions: Adversary	**56.5**	57.3	50.0	**46.2**
C.4. Arm & Hand Movements: Adversary	**50.6**	50.0	53.3	**33.3**
C.5. Head Movements: Adversary	**48.0**	55.0	20.0	**50.0**
C.6. Eye Movements: Adversary	**54.5**	54.0	60.0	**40.0**
Averages	**60.2**	**62.2**	**51.1**	**42.0**

- The most obvious result is not unexpected: evaluators say that the 1995 iteration of TTES is considerably more capable than the 1994 version for training.

- The Total Group gave a reasonable average Overall *Current Capability* rating in 1995 for TTES, 60.2%. This is up over 18 points (more than 40%) from last year.

- The Military respondents generally gave higher *Current Capability* ratings than the Civilians, no doubt due to the current TTES emphasis on military urban terrain scenarios.

Which categories of capabilities are considered right now to be the *best*? The same information shown in the table above is provided below, but sorted so that the categories with the largest average ratings are at the top.

Simulation Capability Categories	Current Capability			
	1995 Total Group	1995 Military	1995 Civilians	1994 Total Group
B.1. Environments	**74.1**	74.7	70.0	**54.3**
A.5. Mission Rehearsal	**73.0**	72.9	73.3	--
A.4. Mission Preview	**72.6**	75.0	60.0	--
A.2. Marksmanship Events	**71.1**	71.4	70.0	**46.3**
A.3. Discretionary Decisions	**70.0**	70.0	70.0	**41.3**
A.1 Training Situations	**69.5**	71.8	60.0	**45.0**
B.4. Simulated Humans	**69.5**	67.8	80.0	**42.9**
B.3. General Objects	**64.4**	66.7	53.3	**42.9**
B.5. Weapons	**63.2**	67.1	30.0	**33.3**
C.2. Individual Body Movements: Trainee	**60.0**	61.3	53.3	**44.6**
B.6. Sounds	**60.0**	65.3	33.3	**30.7**
C.2. Individual Body Movements: Adversary	**58.9**	64.0	33.3	**44.6**
C.1. Tactical Movements: Trainee	**58.0**	60.0	50.0	**40.0**
C.3. Firing Positions: Trainee	**57.3**	56.7	60.0	**46.2**
C.3. Firing Positions: Adversary	**56.5**	57.3	50.0	**46.2**
C.6. Eye Movements: Adversary	**54.5**	54.0	60.0	**40.0**
B.2. Environmental Effects	**54.1**	58.5	40.0	**36.0**
C.5. Head Movements: Trainee	**52.7**	55.6	40.0	**50.0**
C.6. Eye Movements: Trainee	**51.6**	56.0	35.0	**40.0**
C.4. Arm & Hand Movements: Adversary	**50.6**	50.0	53.3	**33.3**
C.4. Arm & Hand Movements: Trainee	**49.0**	51.3	40.0	**33.3**
C.5. Head Movements: Adversary	**48.0**	55.0	20.0	**50.0**
C.1. Tactical Movements: Adversary	**47.1**	49.1	40.0	**40.0**
Averages	**60.2**	**62.2**	**51.1**	**42.0**

- As in 1994, the Environments category is given the top 1995 *Current Capability* rating (74.1%). TTES is perceived as able to emulate a variety of environments useful for weapons use training.

- All categories except Adversary Head Movements are judged better in 1995 than in 1994 and all except Trainee Arm & and Movements and Adversary Head and Tactical Movements are rated above 50% by the Total Group.

- TTES capability to simulate Environmental Effects (weapon impacts, reduced visibility, etc.) may be lagging most other categories, as it also was perceived to be in 1994.

- Judgments of *Current Capability* for both Trainee and Adversary Firing Positions and Body, Eye, Arm & Hand, Head, and Tactical Movements remain somewhat disappointing. All are rated by the Total Group at 60% or less in 1995.

- Simulated Adversary Tactical Movements and Head Movements are rated at the bottom (47.1 and 48.0%) of the *Current Capability* list. This simulation category will be difficult and expensive to improve, due to the complexity of emulating human activities, behavior, and performance.

5.3 HOW CLOSE IS TTES NOW?

A simple ratio was used to determine respondents' perceptions of how close TTES comes at present to meeting its potential: Total Group overall *Current Capability* average values were divided by Total Group *Potential Usefulness* average values and the result multiplied by 100, for each of the 17 categories. Individual category ratios are listed in the following table, sorted so the highest category ratio is at the top. An average ratio for all categories combined is provided at the end of the table.

Similar ratios calculated for the 1994 results also are included in the final column for comparison. The Mission Preview and Mission Rehearsal categories were not included in the 1994 survey. Also, separate ratios were not calculated for the Section C Trainee and Adversary results for the 1994 survey (a weakness of that study), so the 1994 Section C ratios simply are duplicated in the final column.

Simulation Capability Categories	Current-to-Potential Ratios			
	Current Capability	Potential Usefulness	1995 Ratio	1994 Ratio
B.1. Environments	74.1	92.0	81%	63%
A.5. Mission Rehearsal	73.0	93.9	78%	–
A.4. Mission Preview	72.6	94.8	77%	–
A.2. Marksmanship Events	71.1	95.0	75%	58%
A.3. Discretionary Decisions	70.0	95.2	74%	48%
A.1 Training Situations	69.5	95.4	73%	59%
B.4. Simulated Humans	69.5	96.4	72%	52%
B.5. Weapons	63.2	91.0	69%	41%
B.3. General Objects	64.4	96.8	67%	49%
C.6. Eye Movements: Adversary	54.5	86.7	63%	54%
C.2. Individual Body Movements: Trainee	60.0	95.2	63%	51%
C.2. Individual Body Movements: Adversary	58.9	94.3	62%	51%
B.6. Sounds	60.0	98.0	61%	38%
C.3. Firing Positions: Trainee	57.3	96.0	60%	53%
C.3. Firing Positions: Adversary	56.5	93.6	60%	53%
C.1. Tactical Movements: Trainee	58.0	96.2	60%	46%
B.2. Environmental Effects	54.1	92.6	58%	44%
C.5. Head Movements: Trainee	52.7	97.5	54%	59%
C.6. Eye Movements: Trainee	51.6	96.4	54%	54%
C.4. Arm & Hand Movements: Adversary	50.6	93.9	54%	44%
C.5. Head Movements: Adversary	48.0	93.6	51%	59%
C.4. Arm & Hand Movements: Trainee	49.0	95.5	51%	44%
C.1. Tactical Movements: Adversary	47.1	94.7	50%	46%
Averages	60.2	94.6	64%	51%

- From the ratios it can be inferred that the subject matter experts who participated in the 1995 study consider that TTES, as a whole, is about 64% of the way towards meeting its potential, up from a ratio of 51% in 1994.

- Each of the individual simulation categories is perceived as being at least half way there — with a ratio of 50% or higher.

- The Environments category, considered to have the greatest *Current Capability*, is considered closest to completion (81%), with Mission Rehearsal (78%), Mission Preview (77%), and Marksmanship Events (75%) all about three-quarters of the way towards meeting their potential. Discretionary Decisions, Training Situations, and Simulated Humans also achieved high current-to-potential ratios (above 70%).

- Emulation of Sounds, highest in 1995 *Potential Usefulness* ratings and in the middle of the *Current Capability* list, has come a long way this year, moving from the bottom place ratio of 38% in 1994 to 61% in 1995 (a 60% change). Sound capability was added in 1995, when audio-equipped helmets were incorporated into TTES.

5.4 HOW GOOD DOES TTES HAVE TO BE?

New in 1995 were questions on the *Realism Levels* that are required for satisfactory training: how good is "good enough"? These questions were included only for Section B of the survey form, concerning objects, situations, and events. The instructions indicated that a goal is to keep development costs down, so respondents would not simply opt for perfection in all areas. Results are summarized in the following table, sorted with the highest *Realism Level* ratings at the top.

	Required Realism Level Ratings		
Simulation Capability Categories	**Total Group**	**Military**	**Civilians**
B.3. General Objects	**79.3**	78.2	84.0
B.5. Weapons	**78.5**	76.4	88.0
B.6. Sounds	**76.9**	76.2	80.0
B.4. Simulated Humans	**74.8**	73.6	80.0
B.1. Environments	**73.8**	73.3	76.0
B.2. Environmental Effects	**68.5**	67.6	72.0
Averages	**75.3**	**74.2**	**80.0**

- Respondents gave surprisingly high ratings for the level of realism they feel TTES must provide. The overall average calculated rating of 75.3% is below the 80% cutoff for *Exact replication*, but very near the top of the classification referred to as *Good replication, hard to tell it is not real* (see Sections 3.3 and 3.6).

- This result could have serious implications for the cost of TTES development, if potential users actually will require the indicated level of realism. However, we feel that, though real-world realism may be strongly desired, the *Current Capability* ratings indicate that simulations on the level of *Reasonable replication, appearance about as expected*, will meet a lot of training needs that presently cannot be met at all. Nothing in TTES is replicated exactly at present, and many objects barely would be considered *Good replications*; mostly they are *Reasonable* models of what they represent. Yet the 1995 survey respondents have indicated that TTES *Current Capability* is reasonably good as the system is implemented now!

6.0 CONCLUSIONS AND RECOMMENDATIONS

As was explained in Section 4.0, the questionnaire administered to 28 subject matter experts was divided into three sections. Each section addressed a different level of simulation fidelity: first, overall system usefulness structure, and capabilities; second, modeling of objects and events; and, third, detailed modeling of humans. Conclusions related to the three survey sections are provided below, along with a few recommendations. All conclusions are based on Total Group responses.

6.1 OVERALL TTES USEFULNESS

Section A of the survey form included five categories of questions. These categories were (1) current and planned **Training Situations**, (2) training events related to **Marksmanship**, (3) events related to making **Discretionary Decisions** about appropriate responses to possible adversaries, (4) capabilities needed so TTES can be used for **Mission Preview**, and (5) activities to include to use TTES for **Mission Rehearsal** (these last two categories were added for 1995). These five categories concern overall TTES *system structure* and *operation*, the basics upon which the categories included in the follow-on sections of the survey must be built. These categories are integral to TTES development.

- The Total Group rated **Training Situations** highest of the five categories in *Potential Usefulness*, yet it rated TTES's *Current Capability* in this area the lowest of the five (though still markedly improved over the 1994 version). The *Current-Capability*-to-*Potential-Usefulness* ratio also is the lowest of this group of categories.

- **Marksmanship** and **Discretionary Decisions** have switched places in perceived importance or usefulness between 1994 and 1995. While ratings of both have increased substantially, the latter now is rated slightly higher than the former. This may be due to the greater fidelity of human representations in TTES. It now is easier to envision using the system to decide when to engage (instead of simply shooting whatever comes into view).

- The perceived usefulness of TTES in training for **Discretionary Decisions** cannot be overemphasized. The responses of the surveyed subject matter experts gave numerous indications of how unique and useful this function will be.

- Using TTES for **Mission Preview** and **Mission Rehearsal**, not considered separately in 1994, was rated as a very useful function by the 1995 respondents. These new uses for TTES show much promise.

- The perceived *Current Capability* of this entire set of five categories has improved materially in the past year, more than either of the other two sets. The progress made by the TTES developers has not been lost on the subject matter experts who participated in this study.

- The average *Current-to-Potential* ratio for these five categories is over 75%. This might be interpreted to mean that TTES is three-quarters of the way complete in representing the factors included in Section A of the questionnaire.

- From the above points, one possibly could conclude that the gross development of TTES simulations already is quite satisfactory; this conclusion would be in error. Even though the respondents are impressed with the current TTES level of development, they also have made it clear that many individual capabilities they consider potentially useful for training still have a long way to go!

6.2 TTES OBJECTS, SITUATIONS, AND EVENTS

Section B of the 1995 survey form included six categories of questions related to objects, situations, and events. These were (1) **Environments**, (2) **Environmental Effects**, (3) **General Objects**, (4) **Simulated Humans**, (5) **Weapons**, and (6) **Sounds**. These categories of factors define in detail how to model the five general simulation categories included in Section A of the survey form.

- As in 1994, TTES ability to emulate a variety of **Environments** received the highest calculated 1995 *Current Capability* rating of all survey categories, and its *Current-to-Potential* ratio also was the highest.

- *Current Capability* ratings were low for **Environmental Effects**. With calculated *Potential Usefulness* ratings placing it in the *critical* classification, this category has a relatively low *Current-to-Potential* ratio and deserves more attention when funding permits.

- The importance given to **Sounds** in both 1994 and 1995 is very interesting. In last year's report we suggested that the total absence of sounds in the demonstration system magnified their importance. This year, even though verbal commands have been added to the scenarios (and the perceived *Current Capability* rating increased almost 100%), the importance of this category grew to where it was the highest rated in *Potential Usefulness*.

- **Simulated Humans**, while still perceived by study participants as critical factors to model, now must compete with **General Objects** for second or third place (after **Sounds**) in *Potential Usefulness*. Great progress has been made this past year in modeling humans on the battlefield; both the *Current Capability* rating and the *Current-to-Potential* ratio are higher for **Simulated Humans** than for **General Objects** in 1995 (though considerable improvement is perceived in modeling other objects as well as humans). The current TTES emphasis on improving the fidelity of its **Sounds**, **General Objects**, and **Simulated Humans** is well placed, and development should continue.

- **Weapons** once again were at the bottom of this category group (although not by much) in *Potential Usefulness*. This may be an indication that TTES's unique capability to train in Discretionary Decisions is recognized by trainers as its most important contribution to combat readiness, reducing slightly the value of including a large variety of weapons.

- The average *Current-to-Potential* ratio for the six categories of objects, situations, and events is 68% — possibly interpretable as being two-thirds of the way towards what is needed for a fully useful system. However, the required *Realism Level* rating for this group of categories suggests that potential TTES users really would like to see modeling that is much closer to the real world than is currently evidenced in present simulation scenarios.

6.3 TTES TRAINEE MOVEMENTS AND POSITIONS

Section C of the survey asked participants to rate factors in six categories for their effects on the Trainees who will use TTES: (1) **Coordinated Tactical Movements**, (2) **Individual Body Movements**, (3) **Firing Positions**, (4) **Arm & Hand Movements**, (5) **Head Movements**, and (6) **Eye Movements**. These categories of capabilities define the allowed Trainee postures and how Trainees should be able to move, within the bounds of the TTES structure and environments listed in the categories included in the other two survey sections.

- All six categories in this section were rated above 95% in *Potential Usefulness* for Trainees and were included among the top 10 ratings for all 23 survey categories (counting the Trainee and Adversary categories separately).

- For full acceptance, TTES eventually must allow Trainees to move and act as if they actually were in combat situations. To the greatest extent possible their **Coordinated Tactical Movements, Individual Body Movements,** and **Firing Positions** should not be artificially constrained by equipment limitations. This may provide a major challenge for TTES developers.

- The Total Group's overall rating for the *Potential Usefulness* of **Eye Movements** was a surprisingly high 96.4% for Trainees — slightly higher than the ratings for any other category in the group except the highest-rated **Head Movements**.

- *Current Capability* for Trainees may be lagging in this group of categories, especially for **Arm & Hand Movements** (rated at only 49%).

- The average 1995 *Current-to-Potential* ratio for the six Trainee categories in this group was 57%. In 1994 the ratio was 51%. Progress is evident, but not as pronounced as for the other two sets of categories.

6.4 TTES SIMULATED ADVERSARY MOVEMENTS AND POSITIONS

Paralleling the questions related to Trainee movements and positions, Section C of the survey also asked participants to rate factors in six categories that affect the representation of simulated Adversaries: (1) **Coordinated Tactical Movements**, (2) **Individual Body Movements**, (3) **Firing Positions**, (4) **Arm & Hand Movements**, (5) **Head Movements**, and (6) **Eye Movements**. These categories determine the detail with which simulated humans should be modeled for TTES training.

- Modeling simulated adversaries in reasonably realistic detail is considered more important by 1995 respondents than by those in 1994. These results alleviate the 1994 concerns about a general attitude that the adversary is inherently less capable and requires a less sophisticated representation in TTES. Such a perception would be extremely dangerous in real-world combat. Nothing in training must be allowed to reinforce this misconception in any way. The adversaries engaged during TTES training must appear to be bright, clever, and fully capable of carrying out well-planned and skilled **Coordinated Tactical Movements**. Neutrals must be realistic enough so intelligent judgments are needed when deciding whether to engage.

- For simulated Adversaries, all but one of the six categories in this section (**Eye Movements**) were rated above 90% in *Potential Usefulness*. Yet, even with this high rating, all six fell among the bottom 10 *Usefulness* ratings for all 23 survey categories (counting the Trainee and Adversary categories separately).

- As in 1994, these six categories are considered less useful or important to implement for Adversaries than they are for Trainees — though by a much smaller margin than a year earlier.

- *Current Capability* ratings for these Adversary categories generally were among the poorest for the entire 1995 survey. When the Total Group's Trainee and Adversary ratings for the individual categories are directly compared, TTES capability for all categories was rated lower for simulated humans than for Trainees, except for **Arm & Hand Movements** and **Eye Movements**. The gap was widest for **Tactical Movements**.

- Average factor rating for the *Potential Usefulness* of **Eye Movements** was 96.4% for Trainees and 86.7% for simulated Adversaries. This level of fidelity for computer-controlled humans may be perceived as not terribly important for a training system such as TTES.

- The average 1995 *Current-to-Potential* ratio for the six Adversary categories in this group was 57%, the same as for Trainees. In 1994 the values were 51% for both the Trainee and the Adversary. Some progress is perceived, but not as much as for the other two sets of categories.

6.5 FINAL THOUGHTS FOR 1995

The experts' 1994 overall judgment of TTES bears repeating. In that first survey, a large majority of respondents reported that they expect the quality of TTES training to be in the Good-to-Very-Good category when the system is completed. The Total Group of study participants agreed that there is a need for such a system, and they generally concurred that TTES will meet more than 80% of that need. In fact, the 1994 subgroup of Trainers gave TTES a *Potential Capability* value of 85% (as reported in last year's results).

The results for 1995 (when *all* participants were experienced small-arms trainers) are even stronger: the Total Group rating for overall TTES *Potential Usefulness* was calculated to be greater than 94%. If *Potential Capability* (the 1994 term) and *Potential Usefulness* (used in 1995) can be considered very similar concepts, the latest group of TTES evaluators feel that the system will come even closer to meeting military and law enforcement training needs than was perceived by the 1994 experts.

If TTES can provide a high quality trainer that meets over 90% of military and civilian needs for a discretionary decision and marksmanship training system, it could result in phenomenal savings in time, ammunition, and other expenses — and should pay back its development costs in a very short time! Even more important, a system such as TTES will provide military and civilian agencies with the capability to train to higher standards and to challenge trainees in ways not currently possible.

Appendix A: 1995 SURVEY FORM

TTES: Capability and Usefulness for Training

Respondent Information

Name:

Agency and Mailing Address:

Phone Number:

Trainer/Instructor? Yes No No. of Years:

Instructions

- **TTES will be used as a training system for two combat functions:**

1. **Discretionary decision making**: deciding whether a simulated person is hostile, neutral, or friendly and whether to engage, and making the appropriate response.
2. **Marksmanship**: enhancing precision shooting skills.

- **Please rate each item in the following lists:**

1. Indicate how ***capable*** the ***current TTES version*** appears to be.
2. Indicate how ***useful*** the ***planned 2002 TTES version*** will be.

- **Use the following linear 5-point scale to rate each question:**

TTES current capability:	TTES potential usefulness
1 Very good	1 Very useful
2 Good	2 Somewhat useful
3 Borderline	3 Borderline
4 Poor	4 Somewhat useless
5 Very poor	5 Very useless

Please do *not* simply indicate that every item is Very useful . Not all capabilities can be implemented at once, so we need to know which are most critical to include first.

- **For Section B, indicate how realistic TTES simulations must be, for satisfactory training while keeping costs down.** How good is "good enough"?

Thank you for your assistance!
Your written and verbal comments are welcome!

Return survey forms to: MAJ Frank Wysocki (703) 640-2220 or 4788
Amphibious Warfare Technology Directorate
US Marine Corps Systems Command
Quantico, VA 22134

A. Overall TTES Usefulness

1. **TTES training situations**. What training situations should be included in the TTES scenarios and synthetic environment, for maximum TTES usefulness as a training technology?

TTES Training Situation	Current Capability	Potential Usefulness
1. Anti-armor/artillery missions		
2. Immediate action drills		
3. MOUT patrolling operations		
4. Combined arms operations		
5. Neutral evacuation operations		
6. Raid operations		
7. Ambush operations		
8. Recon operations		
9. Demolition/EOD operations		
10. Squad & fire team tactics		
11. Obstacle breaching tactics		
12. Fighting hole tactics		
13. Advance-through-terrain activities		
14. Advance-through-urban areas		
15. Sniping activities		
16. Building clearing		
17. Room clearing		
18. Close-quarter-battle		
19. Perimeter defense		
20. Trench warfare		
21. Hostage rescue team activities		
22. Guard duty		
23. Care for wounded		
24. Unit-to-unit coordination		
25. Small unit leadership practice		
26. Land navigation practice		
27. Combat rehearsals		
28. Other (specify)		
29. Overall TTES capability: Training Situations		

2. **TTES events: marksmanship**. What events should be included in the TTES scenarios and synthetic environment to aid in marksmanship training?

Marksmanship Events	Current Capability	Potential Usefulness
1. Close-range shots		
2. Long-range shots		
3. Targets at unknown ranges		
4. Quick aim/fire		
5. Precision shots at small targets		
6. Sniping		
7. Multiple targets, multiple shots		
8. Sustained rate of fire		
9. Track moving targets		
10. Fire at moving targets		
11. Awkward shooting positions		
12. Indoor shots		
13. Shoot while moving		
14. Reload weapon		
15. Clear weapon malfunctions		
16. Change weapons (rifle/pistol)		
17. Throw grenades		
18. Other (specify)		
19. Overall TTES capability: Marksmanship Events		

3. **TTES events: discretionary decisions**. What events should be included in the TTES scenarios and synthetic environment to aid in making decisions about responses to possible adversaries?

Discretionary Decisions	Current Capability	Potential Usefulness
1. Snipers in area		
2. Individual hostiles in area		
3. Hostile crowds		
4. Unknowns in area		
5. Friendlies/Allied troops in area		
6. Villagers/bystanders in area		
7. Hostages in area		
8. Threatening weapon presentation		
9. Non-threatening weapon presentation		
10. Fleeing enemy		
11. Wounded enemy		
12. Enemy prisoners of war		
13. Enemies in Allied uniforms		
14. Other (specify)		
15. Overall TTES capability: Discretionary Decisions		

4. **TTES use: mission preview**. Mission preview is a mission planning function for a specific area and military operation. No dynamic interactions with the environment or potential adversaries are needed. It is simply a virtual walk-through of the objective area. What capabilities should TTES provide for mission preview?

TTES Mission Preview	Current Capability	Potential Usefulness
1. Familiarize and retain familiarization		
2. Visualize approach and routes		
3. Visualize obstacles and danger zones		
4. Visualize potential kill zones		
5. Evaluate sectors of fire for defense/offense		
6. Locate supplementary/alternate positions for defense/offense		
7. Evaluate courses of action		
8. Solidify plan of action		
9. Overall TTES capability: Mission Preview		

5. **TTES use: mission rehearsal**. Mission rehearsal is a mission preparation function — conducting a simulated operation or tactical sequence in a specific dynamic environment. Hostile and neutral forces are tailored to the expected adversary profile. The goals are to validate a concept of operations and to assess the scenario and potential outcome. What capabilities should TTES provide for mission rehearsal?

TTES Mission Rehearsal	Current Capability	Potential Usefulness
1. Immediate action reaction to sniper fire		
2. Immediate action reaction to ambush		
3. Cross danger point		
4. Deal with threat point		
5. React to hostile presence		
6. React to neutral presence		
7. Move to supplementary/alternate positions		
8. Evaluate movement techniques		
9. Compare simulation outcomes to expectation		
10. Evaluate courses of action		
11. Evaluate plan of action		
12. Solidify plan of action		
13. Overall TTES capability: Mission Rehearsal		

B. TTES Objects, Situations, and Events

1. **Environments to simulate in TTES**. What natural and man-made environments should be simulated in the TTES synthetic environment?

TTES Environments	Current Capability	Potential Usefulness
1. Urban: city		
2. Urban: village		
3. Farmland		
4. Desert		
5. Jungle		
6. Arctic/winter		
7. NBC environments		
8. Federal buildings		
9. Prisons		
10. Ships, submarines		
11. Other (Specify)		
12. Overall TTES capability: Environments		

1.a. Realism level <u>required</u> for satisfactory training. How good is "good enough"? <u>Choose one</u>:

1. Exact replication of real-world areas and environments.
2. Good replication, hard to tell it is not real.
3. Reasonable replication, appearance about as expected for this kind of area or environment
4. So-so replication, appearance somewhat realistic.
5. Crude approximation, just enough to recognize area or environment.

2. **Environment effects**. What realistic environmental (physical) occurrences in the engagement area will influence TTES trainees to react tactically to the changing scenarios?

TTES Environments	Current Capability	Potential Usefulness
1. Small arms projectile impacts		
2. Automatic weapons projectile impacts		
3. Pistol projectile impacts		
4. Mortar impacts		
5. Shoulder-launched rocket impacts		
6. Grenade impacts		
7. Structure fires		
8. Reduced visibility (fog, rain)		
9. Other (Specify)		
10. Overall TTES capability: Environment Effects		

2.a. Realism level <u>required</u> for satisfactory training. How good is "good enough"? <u>Choose one</u>:

1. Exact replication of real-world weapons and environmental effects.
2. Good replication, hard to tell it is not real.
3. Reasonable replication, appearance about as expected for this weapon's or environment's effects.
4. So-so replication, weapon and environmental effects somewhat realistic.
5. Crude approximation, just enough to know where weapon has struck or the kind of environment.

3. **General objects in TTES environment**. What realistic general objects should be present in the TTES synthetic environment to add realism to training situations?

TTES General Objects	Current Capability	Potential Usefulness
1. Animals		
2. Trees, bushes (obstacles & cover)		
3. Rocks (obstacles & cover)		
4. Rivers, lakes, etc.		
5. Bridges		
6. Roads		
7. Vehicles		
8. Barbed wire/concertina		
9. Traps, trip wires, mines		
10. Explosions		
11. Burning objects		
12. Incoming fire		
13. Target hits		
14. Debris		
15. Rubble		
16. Buildings		
17. Doors & windows		
18. Furniture		
19. Other (specify)		
20. Overall TTES capability: General Objects		

3.a. Realism level <u>required</u> for satisfactory training. How good is "good enough"? <u>Choose one</u>:

1. Exact replication of real-world objects.
2. Good replication, hard to tell it is not real.
3. Reasonable replication, appearance about as expected for this kind of object.
4. So-so replication, appearance somewhat realistic.
5. Crude approximation, just enough to recognize this kind of object.

4. **Simulated humans in TTES environment**. What humans should be present in the TTES synthetic environment for trainees to interact with, as they go through training situations?

TTES Simulated Humans	Current Capability	Potential Usefulness
1. Snipers		
2. Hostiles		
3. Unknowns		
4. Friendlies		
5. Villagers/innocent bystanders		
6. Hostages		
7. Other (specify)		
8. Overall TTES capability: Simulated Humans		

4.a. Realism level <u>required</u> for satisfactory training. How good is "good enough"? <u>Choose one</u>:

1. Exact replication of real-world humans.
2. Good replication, hard to tell it is not real.
3. Reasonable replication, appearance about as expected for this kind of human.
4. So-so replication, appearance somewhat realistic.
5. Crude approximation, just enough to recognize kind of human.

5. **Weapons in TTES environment**. What weapon systems should be present in the TTES synthetic environment for trainees to practice using and to interact with?

TTES Weapons	Current Capability	Potential Usefulness
1. Assault rifles		
2. Pistols		
3. Submachine guns		
4. Machine guns		
5. Explosive charges		
6. Mortars		
7. Flashbangs		
8. Grenades		
9. Satchel charges		
10. Squad automatic weapons		
11. Shoulder-launched missiles/ rockets		
12. Knives		
13. Other (specify)		
14. Overall TTES capability: Weapons		

5.a. Realism level required for satisfactory training. How good is "good enough"? Choose one:

1. Exact replication of real weapon.
2. Good replication, hard to tell it is not real.
3. Reasonable replication, appearance about as expected for this kind of weapon.
4. So-so replication, appearance somewhat realistic.
5. Crude approximation, just enough to recognize this kind of weapon.

6. **Sounds in TTES environment**. What audible sounds should be present in the TTES synthetic environment to add realism to training situations?

TTES Sounds	Current Capability	Potential Usefulness
1. Explosions		
2. Weapon functioning		
3. Trees & branches snapping		
4. Footsteps		
5. Verbal commands		
6. Normal conversations		
7. Excited chatter		
8. Other (specify)		
9. Overall TTES capability: Simulated Sounds		

6.a. Realism level <u>required</u> for satisfactory training. How good is "good enough"? <u>Choose one</u>:

1. Exact replication of real-world sounds.
2. Good replication, hard to tell it is not real.
3. Reasonable replication, appearance about as expected for this kind of sound.
4. So-so replication, appearance somewhat realistic.
5. Crude approximation, just enough to recognize this kind of sound.

C. Trainee and Adversary Movements and Positions

1.a. **Trainee coordinated tactical movements**. What coordinated tactical movements should TTES allow trainees to perform in the simulator, as they go through simulated training situations?

1.b. **Simulated adversary coordinated tactical movements**. What coordinated tactical movements should TTES simulate for hostiles, neutrals, and friendlies, for various training situations?

	Trainee		Adversary	
Coordinated Tactical Movements	**Current Capability**	**Potential Usefulness**	**Current Capability**	**Potential Usefulness**
1. Use hand & arm signals				
2. Enter building				
3. Enter room				
4. Enter ambush site				
5. Enter vehicle				
6. Patrol				
7. Control crowds/marshal people				
8. Rush (fire & move)				
9. Fire & maneuver				
10. Cover moving buddies				
11. Pick up/carry injured buddy				
12. Other (specify)				
13. Overall TTES capability: Coordinated Tactical Movements				

2.a. **Individual trainee body movements**. What tactically-correct whole-body movements should TTES allow trainees to perform in the simulator?

2.b. **Simulated adversary movements**. What whole-body movements should TTES simulate for hostiles, neutrals, and friendlies, as trainees encounter them during training situations?

	Trainee		Adversary	
Individual Body Movements	**Current Capability**	**Potential Usefulness**	**Current Capability**	**Potential Usefulness**
1. Squat/duck walk				
2. Kneel down				
3. Lie down on front				
4. Lie down on back				
5. Roll right & left				
6. Hit & roll				
7. Stand up				
8. Lean over				
9. Rotate body				
10. Duck				
11. Crawl				
12. Walk forwards				
13. Walk backwards				
14. Run				
15. Jump				
16. Climb/crawl over obstacles				
17. Dive behind cover				
18. Other (specify)				
19. Overall TTES capability: Individual Body Movements				

3.a. **Trainee firing positions**. What tactically-correct firing positions and other body positions should TTES allow trainees to use in the simulator?

3.b. **Simulated adversary positions**. What firing positions and other body positions should TTES be able to simulate for hostiles, neutrals, and friendlies, as trainees decide whether to fire?

	Trainee		Adversary	
Firing Positions	**Current Capability**	**Potential Usefulness**	**Current Capability**	**Potential Usefulness**
1. Prone				
2. Kneeling				
3. Standing				
4. Sitting				
5. Squatting or crouched				
6. On back				
7. Supported				
8. Barricaded				
9. Through windows				
10. Through doors				
11. From holes				
12. From under vehicles				
13. From behind trees				
14. Others (specify)				
15. Overall TTES capability: Firing Positions				

4.a. **Trainee arm and hand movements**. What tactically-correct arm and hand movements should TTES allow trainees to perform in the simulator, as they move through training situations?

4.b. **Simulated adversary arm and hand movements**. What tactically-correct arm and hand movements should TTES be able to simulate for hostiles, neutrals, and friendlies, as trainees go through training situations?

	Trainee		Adversary	
Arm & Hand Movements	**Current Capability**	**Potential Usefulness**	**Current Capability**	**Potential Usefulness**
1. Up & down				
2. Left & right				
3. Diagonal (up & to the right, etc.)				
4. Bend elbows & wrists				
5. Reach for objects				
6. Grab or grasp objects				
7. Pick up objects				
8. Throw objects (e.g., grenades)				
9. Change hands				
10. Push objects away				
11. Open doors				
12. Open windows				
13. Draw weapons				
14. Manipulate weapons				
15. Shoot weapons				
16. Transition between weapons				
17. Use rifle as pugil				
18. Other (specify)				
19. Overall TTES capability: Arm & Hand Movements				

5.a. **Trainee head movements**. What tactically-correct trainee head movements are trainees likely to perform and for which TTES should provide a simulated field of regard?

5.b. **Simulated adversary head movements**. What tactically-correct head movements should TTES be able to simulate for hostiles, neutrals, and friendlies?

	Trainee		Adversary	
Head Movements	**Current Capability**	**Potential Usefulness**	**Current Capability**	**Potential Usefulness**
1. Up & down				
2. Left & right				
3. Diagonal (up & to the right, etc.)				
4. Slow scan of area				
5. Fast tracking of moving object				
6. Look over shoulder/behind				
7. Peek/look around corner				
8. Peek/look over obstacle				
9. Bend & look				
10. Duck				
11. Put face in dirt				
12. Aim through sight				
13. Other (specify)				
14. Overall TTES capability: Head Movements				

6.a. **Trainee eye movements**. What tactically-correct eye movements are trainees likely to perform and for which TTES should provide a simulated field of regard?

6.b. **Simulated adversary eye movements**. What tactically-correct eye movements should TTES be able to simulate for hostiles, neutrals, and friendlies?

	Trainee		Adversary	
Eye Movements	**Current Capability**	**Potential Usefulness**	**Current Capability**	**Potential Usefulness**
1. Up & down				
2. Left & right				
3. Diagonal (up & to the right, etc.)				
4. Scan area, limited head motion				
5. Fast tracking of moving objects				
6. Through peep holes				
7. Sight alignment				
8. Other (specify)				
9. Overall TTES capability: Eye Movements				

Appendix B: MISSION PREVIEW AND MISSION REHEARSAL

The Mission Preview and Mission Rehearsal categories were not included in the 1994 evaluation of perceived TTES training value. As the year progressed, the potential usefulness of these possible TTES functions became obvious, so the two categories were added to the 1995 questionnaire for evaluation by the 28 subject matter experts who participated in the survey.

In addition, a second group completed a separate questionnaire dealing only with Mission Preview and Mission Rehearsal. Twelve enlisted men and one officer from the Second Marine Division, Camp Lejeune, North Carolina, completed this questionnaire. Five of these had seen combat in Haiti or Liberia; the rest had never been in combat.

These survey respondents reviewed a map of the objective area, which was the Marine Corps MOUT II Quantico Combat Training Village modeled in TTES, and also used TTES to preview and rehearse a mission. That mission then was carried out as an exercise in the Combat Training Village, prior to completion of the questionnaire.

Since the Mission Preview and Mission Rehearsal capabilities listed on the questionnaire for this group were not the same as those on the 1995 training value survey form, results could not be combined. Instead, calculated ratings are provided in the following tables for that separate group of respondents. Responses are sorted so the Total Group's highest rated capabilities are at the top.

1. Using TTES for Mission Preview.
Mission preview is a mission planning function for a specific area and military operation. No dynamic interactions with the environment or potential adversaries are needed. It is simply a virtual walk-through of the objective area. What capabilities should TTES provide for mission preview?

Potential Usefulness of Listed Factors for Mission Preview

	Potential Usefulness Rating		
Mission Preview	**Total Group**	**No Combat**	**Combat**
Familiarize & retain familiarization of objective area	**96.9**	100.0	92.0
Solidify plan of action	**96.9**	97.5	96.0
Evaluate sectors of fire for offense/defense	**95.4**	100.0	88.0
Visualize own avenue of approach and routes	**95.4**	97.5	92.0
Familiarize with building layout and arrangement	**93.8**	95.0	92.0
Visualize obstacles to movement and danger zones	**90.8**	100.0	76.0
Evaluate weapon positions for defense/offense	**90.8**	87.5	96.0
Evaluate courses of action	**87.7**	87.5	88.0
Visualize check/reference points	**86.2**	92.5	76.0
Locate supplementary/alternate positions for defense/offense	**86.2**	92.5	76.0
Visualize potential kill zones	**86.2**	87.5	84.0
Visualize covered routes	**86.2**	87.5	84.0
Visualize obstacles to observation	**84.6**	85.0	84.0
Visualize deadspace for weapons	**84.6**	80.0	92.0
Visualize avenues of approach against you	**83.1**	85.0	80.0
Familiarize with floorplans of buildings encountered	**83.1**	82.5	84.0
Potential **Overall TTES usefulness: Mission Preview**	**100.0**	**100.0**	**100.0**

Current Capability of TTES to Emulate Listed Factors for Mission Preview

Mission Preview	Current Capability Rating		
	Total Group	No Combat	Combat
Visualize own avenue of approach and routes	**95.4**	95.0	96.0
Evaluate sectors of fire for offense/defense	**83.1**	82.5	84.0
Solidify plan of action	**83.1**	80.0	88.0
Familiarize & retain familiarization of objective area	**81.5**	80.0	84.0
Familiarize with building layout and arrangement	**80.0**	77.5	84.0
Visualize obstacles to movement and danger zones	**78.5**	80.0	76.0
Locate supplementary/alternate positions for defense/offense	**78.5**	80.0	76.0
Evaluate courses of action	**75.4**	72.5	80.0
Visualize potential kill zones	**73.8**	80.0	64.0
Visualize check/reference points	**73.8**	80.0	64.0
Evaluate weapon positions for defense/offense	**73.8**	70.0	80.0
Familiarize with floorplans of buildings encountered	**70.8**	65.0	80.0
Visualize covered routes	**69.2**	75.0	60.0
Visualize obstacles to observation	**69.2**	70.0	68.0
Visualize avenues of approach against you	**64.6**	62.5	68.0
Visualize deadspace for weapons	**60.0**	50.0	76.0
***Current* Overall TTES capability: Mission Preview**	**83.3**	**80.0**	**88.0**

1. **Using TTES for <u>Mission Rehearsal</u>.**
   Mission rehearsal is a mission preparation function — conducting a simulated operation or tactical sequence in a specific dynamic environment. Hostile and neutral forces are tailored to the expected adversary profile. The goals are to validate a concept of operations and to assess the scenario and potential outcome. What capabilities should TTES provide for mission rehearsal?

Potential Usefulness of Listed Factors for Mission Rehearsal

Mission Rehearsal	Potential Usefulness Rating		
	Total Group	No Combat	Combat
React to hostile presence	**98.3**	100.0	96.0
React to neutral presence	**96.7**	100.0	92.0
Try out avenue of approach	**95.0**	97.1	92.0
Cross danger point	**93.3**	100.0	84.0
Evaluate plan of action	**93.3**	97.1	88.0
Try out defensive/offensive actions	**91.7**	97.1	84.0
Deal with threat point	**90.0**	100.0	76.0
Evaluate courses of action	**90.0**	88.6	92.0
Move to supplementary/alternate positions	**88.3**	88.6	88.0
Compare simulation outcomes to expectation	**85.5**	85.7	85.0
Evaluate movement techniques	**81.7**	88.6	72.0
Immediate action reaction to ambush	**81.7**	82.9	80.0
Solidify plan of action	**81.7**	74.3	92.0
React to being probed	**80.0**	88.6	68.0
Immediate action reaction to sniper fire	**75.0**	82.9	64.0
***Potential* Overall TTES usefulness: Mission Rehearsal**	**98.0**	**100.0**	**96.0**

Current Capability of TTES to Emulate Listed Factors for Mission Rehearsal

Mission Rehearsal	Current Capability Rating		
	Total Group	No Combat	Combat
React to neutral presence	**86.7**	85.7	88.0
Try out avenue of approach	**83.3**	82.9	84.0
Cross danger point	**83.3**	82.9	84.0
Evaluate plan of action	**83.3**	82.9	84.0
Evaluate courses of action	**81.7**	82.9	80.0
React to hostile presence	**81.7**	77.1	88.0
Deal with threat point	**78.3**	80.0	76.0
Try out defensive/offensive actions	**76.7**	77.1	76.0
Solidify plan of action	**75.0**	68.6	84.0
Compare simulation outcomes to expectation	**72.7**	68.6	80.0
Evaluate movement techniques	**71.7**	77.1	64.0
Move to supplementary/alternate positions	**71.7**	65.7	80.0
Immediate action reaction to ambush	**70.0**	74.3	64.0
React to being probed	**66.7**	68.6	64.0
Immediate action reaction to sniper fire	**61.7**	65.7	56.0
***Current* Overall TTES capability: Mission Rehearsal**	**82.0**	**80.0**	**84.0**

The respondents for this survey also were asked to provide comments on whether the use of TTES improved their ability to perform or execute the mission. They were asked to compare the virtual preparation with the live exercise and to report whether they were better prepared and more confident, and whether they knew what they were doing as a result of the opportunity to preview and rehearse the mission. Responses included the following.

- A combination of both the map and technology helps [make] the mission a little easier to understand.

- It gives a step by step of what would be encountered. I felt I knew the terrain. It was clear what the best way of approach was.

- I had an idea of where snipers could position themselves and I knew exactly how to provide security for my team.

- It gave us a visual picture of the whole town. I think that a visual picture and a walk through the town through the system is 100x better than doing a map recon while you [are] trying to explain everything to your Sqd [Squad] or Fr Tm [Fire Team]. You can actually show them so they know. And there is no doubt in your mind that they [may not] know what they are doing. I knew exactly what I was doing and what my tasks were.

- My team leader told me and he backed it up with the computer.

- It prepared me for the mission: where to go, etc. It gave me a heads up on what I was going against before it actually happened.

- The TTES helped a lot to prepare me/Squad in knowing where each individual needed to be before the mission started. I felt confident in knowing building structure/floor plans, but the buildings need external identifiers (i.e., Hotel, Bank, etc.).

- I recalled all of the info, because I [had] seen it. It improved my ability to perform by having a mental picture.

- It was like replaying a movie in my mind. I knew exactly what I was supposed to do and also where all of my team and I were supposed to be.... My team knew also because we saw it on the screen. We all saw what we had to do exactly and I knew my team was LOCKED ON!!

- The only problem was that one of the buildings you see on the screen is not the same as in reality. It did provide me with a better mental picture that I was able to apply once we encountered the building. The experience improved my ability to perform and execute the mission for the simple reason that I was able to have a detailed mental picture of the area before I even [had] seen it in reality. I did know what I was doing because I went over it with my team and SQ on the virtual screen a few times before doing it.

- Great tool for evaluating team performance. Controller screen gives a good view.

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